

AD-A183 992

LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND

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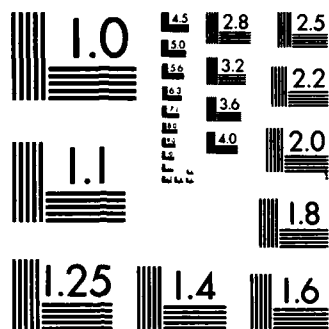
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FMC-E-3041-VOL-D2-PT-4 DAAA21-86-C-0047

F/G 19/6

NL

A 10x10 grid of 100 small images. The images show a variety of patterns and textures, including solid colors, gradients, and complex, abstract shapes. Some images appear to be generated by a model, showing a range of visual styles and features. The patterns range from simple geometric shapes to more complex, organic-looking structures. The overall effect is a diverse collection of visual outputs from a generative model.



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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Lightweight Towed Howitzer Demonstrator

Final Report

Volume D2 - Part IV

Structural Analysis of Cradle

April 1987

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AD-A183 992

Contract Number DAAA21-86-C-0047

FMC CORPORATION
Northern Ordnance Division
4800 East River Road
Minneapolis, Minnesota 55421

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1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A183 991	3. RECIPIENT'S CATALOG NUMBER
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) 55mm towed gun howitzer, advanced weapons, composite cradle, composite hydraulic actuators, composite trails, field artillery weapon, firing stability analysis, howitzers, hydraulic control valves with force feedback, hydraulic joystick control of gun direction, hydraulic inertial rammer, hydraulic opening breech, hydraulic primer autoloader, lightweight towed howitzer demonstrator (LTHD) , load out of battery howitzer, mortar howitzer, recoil energy recovery, recoil mechanism, using metal matrix compos- sites, titanium muzzle brake, titanium platform, titanium spade, titanium walking beams, thermal stability, towing stability analysis, unconventional weapons, and weight reduction of artillery		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The LTHD (Lightweight Towed Howitzer Demonstrator) was to be a 9,000 lb equivalent to the M198, transportable via Blackhawk helicopter, with reduced emplacement time using fewer personnel. The FMC design achieved weight reduction via a mortar-like configuration, composites structure, and hydraulic actuators. Recovery of power from the recoil system, in turn, facilitated crew reduction via hydraulic emplacement, four-way joystick tube lay, and power ramming. FMC completed Concept Development (Ph I) and two-thirds of Detailed Design (Ph II) prior to funds running out. <i>Key...</i>		

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Distribution/	
Availability Codes	
Dist	Avail and/or
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D2/350

CRADLE MODEL/PLOTS

LIST SELECTED ELEM. IN RANGE 100 TO 800 BY 1 (LIST NODES)

ELER MAT TYP REL	NODES
100 1 1 1	378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800

NOTE: LINES NO OR CONTINUOUS

ELER MAT TYP REL	NODES
100 1 1 1	461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800

ELER MAT TYP REL	NODES
100 1 1 1	547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800

ELER MAT TYP REL	NODES
100 3 2 2	673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800

172	2	2	2	8045	8152	8258	8364	8470	8576	8682	8788	8894	8900	8906	8912	8918	8924	8930	8936	8942	8948	8954	8960	8966	8972	8978	8984	8990	8996	9002	9008	9014	9020	9026	9032	9038	9044	9050	9056	9062	9068	9074	9080	9086	9092	9098	9104	9110	9116	9122	9128	9134	9140	9146	9152	9158	9164	9170	9176	9182	9188	9194	9200	9206	9212	9218	9224	9230	9236	9242	9248	9254	9260	9266	9272	9278	9284	9290	9296	9302	9308	9314	9320	9326	9332	9338	9344	9350	9356	9362	9368	9374	9380	9386	9392	9398	9404	9410	9416	9422	9428	9434	9440	9446	9452	9458	9464	9470	9476	9482	9488	9494	9500	9506	9512	9518	9524	9530	9536	9542	9548	9554	9560	9566	9572	9578	9584	9590	9596	9602	9608	9614	9620	9626	9632	9638	9644	9650	9656	9662	9668	9674	9680	9686	9692	9698	9704	9710	9716	9722	9728	9734	9740	9746	9752	9758	9764	9770	9776	9782	9788	9794	9800	9806	9812	9818	9824	9830	9836	9842	9848	9854	9860	9866	9872	9878	9884	9890	9896	9902	9908	9914	9920	9926	9932	9938	9944	9950	9956	9962	9968	9974	9980	9986	9992	9998	10004	10010	10016	10022	10028	10034	10040	10046	10052	10058	10064	10070	10076	10082	10088	10094	10100	10106	10112	10118	10124	10130	10136	10142	10148	10154	10160	10166	10172	10178	10184	10190	10196	10202	10208	10214	10220	10226	10232	10238	10244	10250	10256	10262	10268	10274	10280	10286	10292	10298	10304	10310	10316	10322	10328	10334	10340	10346	10352	10358	10364	10370	10376	10382	10388	10394	10400	10406	10412	10418	10424	10430	10436	10442	10448	10454	10460	10466	10472	10478	10484	10490	10496	10502	10508	10514	10520	10526	10532	10538	10544	10550	10556	10562	10568	10574	10580	10586	10592	10598	10604	10610	10616	10622	10628	10634	10640	10646	10652	10658	10664	10670	10676	10682	10688	10694	10700	10706	10712	10718	10724	10730	10736	10742	10748	10754	10760	10766	10772	10778	10784	10790	10796	10802	10808	10814	10820	10826	10832	10838	10844	10850	10856	10862	10868	10874	10880	10886	10892	10898	10904	10910	10916	10922	10928	10934	10940	10946	10952	10958	10964	10970	10976	10982	10988	10994	11000	11006	11012	11018	11024	11030	11036	11042	11048	11054	11060	11066	11072	11078	11084	11090	11096	11102	11108	11114	11120	11126	11132	11138	11144	11150	11156	11162	11168	11174	11180	11186	11192	11198	11204	11210	11216	11222	11228	11234	11240	11246	11252	11258	11264	11270	11276	11282	11288	11294	11300	11306	11312	11318	11324	11330	11336	11342	11348	11354	11360	11366	11372	11378	11384	11390	11396	11402	11408	11414	11420	11426	11432	11438	11444	11450	11456	11462	11468	11474	11480	11486	11492	11498	11504	11510	11516	11522	11528	11534	11540	11546	11552	11558	11564	11570	11576	11582	11588	11594	11600	11606	11612	11618	11624	11630	11636	11642	11648	11654	11660	11666	11672	11678	11684	11690	11696	11702	11708	11714	11720	11726	11732	11738	11744	11750	11756	11762	11768	11774	11780	11786	11792	11798	11804	11810	11816	11822	11828	11834	11840	11846	11852	11858	11864	11870	11876	11882	11888	11894	11900	11906	11912	11918	11924	11930	11936	11942	11948	11954	11960	11966	11972	11978	11984	11990	11996	12002	12008	12014	12020	12026	12032	12038	12044	12050	12056	12062	12068	12074	12080	12086	12092	12098	12104	12110	12116	12122	12128	12134	12140	12146	12152	12158	12164	12170	12176	12182	12188	12194	12200	12206	12212	12218	12224	12230	12236	12242	12248	12254	12260	12266	12272	12278	12284	12290	12296	12302	12308	12314	12320	12326	12332	12338	12344	12350	12356	12362	12368	12374	12380	12386	12392	12398	12404	12410	12416	12422	12428	12434	12440	12446	12452	12458	12464	12470	12476	12482	12488	12494	12500	12506	12512	12518	12524	12530	12536	12542	12548	12554	12560	12566	12572	12578	12584	12590	12596	12602	12608	12614	12620	12626	12632	12638	12644	12650	12656	12662	12668	12674	12680	12686	12692	12698	12704	12710	12716	12722	12728	12734	12740	12746	12752	12758	12764	12770	12776	12782	12788	12794	12800	12806	12812	12818	12824	12830	12836	12842	12848	12854	12860	12866	12872	12878	12884	12890	12896	12902	12908	12914	12920	12926	12932	12938	12944	12950	12956	12962	12968	12974	12980	12986	12992	12998	13004	13010	13016	13022	13028	13034	13040	13046	13052	13058	13064	13070	13076	13082	13088	13094	13100	13106	13112	13118	13124	13130	13136	13142	13148	13154	13160	13166	13172	13178	13184	13190	13196	13202	13208	13214	13220	13226	13232	13238	13244	13250	13256	13262	13268	13274	13280	13286	13292	13298	13304	13310	13316	13322	13328	13334	13340	
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LIST SELECTED ELEM. IN RANGE 800 TO 400 BY 1 (LIST MODES)

[illegible]

more (VES. NO OR CONTINUOUS) -
P

FLOW RATE (YD ³ /SEC)	MODES											
0.11	2	2	2	268	310	304	642	612	307	300	658	
				674	316	311	671	671	308	640	664	
0.12	2	2	2	275	317	305	663	663	307	341	336	
				643	308	306	665	665	348	334	334	
				348	314	302	652	652	348	348	348	
0.13	2	2	2	285	307	300	646	646	349	346	332	
				678	300	300	648	648	360	375	336	
				337	351	347	333	337	309	481	370	
0.14	2	2	2	327	341	340	335	337	423	481	381	
				682	340	336	676	676	481	381	381	
				342	348	344	334	334	481	381	381	
0.15	2	2	2	337	339	338	334	339	481	482	380	
				677	333	331	681	681	482	384	384	
				348	400	427	385	385	482	482	384	
0.16	2	2	2	359	401	422	380	385	387	419	377	
				698	426	426	682	682	418	680	376	
				358	402	420	383	383	418	680	376	
0.17	2	2	2	376	402	420	383	383	421	414	378	
				676	350	375	681	681	425	678	385	
				348	450	473	371	371	425	678	385	

ELLER PAT	Typ	REL	MODES									
210	2	2	379	421	414	372	380	422	416	374		
			681	426	678	383	682	428	679	386		
219	2	2	395	427	416	373	377	419	378			
			682	428	679	386	680	429	677	376		
280	2	2	387	429	417	375						
			356	397	419	377	643	507	607	465		
			636	410	680	376						
221	2	2	440	488	508	466	423	495	506	464		
			612	493	695	482	614	496	698	484		
			442	484	511	469	464	510	468	488		
222	2	2	443	495	506	464	430	481	503	461		
			644	498	688	483	642	502	685	480		
223	2	2	444	496	513	471						
			378	410	416	376	467	505	460	456		
			465	506	497	465	397	509	464	467		
224	2	2	463	506	498	464	464	506	500	458		
			687	509	684	467	688	512	685	470		
			469	511	499	467						

ELER PART	TOP REL	MODES			
225	2	2	464	808	458
			688	512	485
			711	513	501
226	2	2	430	481	503
			622	528	606
			524	635	552
					550
			461	806	458
			686	504	485
			567	589	507
			601	603	540

ELEN MAT TYP REL				MODES									
227	2	2	2	567	533	547	537	529	537	539	540	545	
				568	534	548	538	530	538	540	541	546	
				569	535	549	539	531	539	541	542	547	
228	2	2	2	537	540	550	540	523	535	537	545	545	
				538	541	551	541	524	536	538	546	546	
				539	542	552	542	525	537	539	547	547	
229	2	2	2	528	570	597	585	547	530	532	540	540	
				529	571	598	586	548	531	533	541	541	
				530	572	599	587	549	532	534	542	542	
230	2	2	2	550	592	621	613	553	553	558	565	565	
				551	593	622	614	554	554	559	566	566	
				552	594	623	615	555	555	560	567	567	
231	2	2	2	529	593	620	611	548	537	540	548	548	
				530	594	621	612	549	538	541	549	549	
				531	595	622	613	550	539	542	550	550	
				532	596	623	614	551	540	543	551	551	
				533	597	624	615	552	541	544	552	552	
				534	598	625	616	553	542	545	553	553	
				535	599	626	617	554	543	546	554	554	
				536	600	627	618	555	544	547	555	555	
				537	601	628	619	556	545	548	556	556	
				538	602	629	620	557	546	549	557	557	
				539	603	630	621	558	547	550	558	558	
				540	604	631	622	559	548	551	559	559	
				541	605	632	623	560	549	552	560	560	
				542	606	633	624	561	550	553	561	561	
				543	607	634	625	562	551	554	562	562	
				544	608	635	626	563	552	555	563	563	
				545	609	636	627	564	553	556	564	564	
				546	610	637	628	565	554	557	565	565	
				547	611	638	629	566	555	558	566	566	
				548	612	639	630	567	556	559	567	567	
				549	613	640	631	568	557	560	568	568	
				550	614	641	632	569	558	561	569	569	
				551	615	642	633	570	559	562	570	570	
				552	616	643	634	571	560	563	571	571	
				553	617	644	635	572	561	564	572	572	
				554	618	645	636	573	562	565	573	573	
				555	619	646	637	574	563	566	574	574	
				556	620	647	638	575	564	567	575	575	
				557	621	648	639	576	565	568	576	576	
				558	622	649	640	577	566	569	577	577	
				559	623	650	641	578	567	570	578	578	
				560	624	651	642	579	568	571	579	579	
				561	625	652	643	580	569	572	580	580	
				562	626	653	644	581	570	573	581	581	
				563	627	654	645	582	571	574	582	582	
				564	628	655	646	583	572	575	583	583	
				565	629	656	647	584	573	576	584	584	
				566	630	657	648	585	574	577	585	585	
				567	631	658	649	586	575	578	586	586	
				568	632	659	650	587	576	579	587	587	
				569	633	660	651	588	577	580	588	588	
				570	634	661	652	589	578	581	589	589	
				571	635	662	653	590	579	582	590	590	
				572	636	663	654	591	580	583	591	591	
				573	637	664	655	592	581	584	592	592	
				574	638	665	656	593	582	585	593	593	
				575	639	666	657	594	583	586	594	594	
				576	640	667	658	595	584	587	595	595	
				577	641	668	659	596	585	588	596	596	
				578	642	669	660	597	586	589	597	597	
				579	643	670	661	598	587	590	598	598	
				580	644	671	662	599	588	591	599	599	
				581	645	672	663	600	589	592	600	600	
				582	646	673	664	601	590	593	601	601	
				583	647	674	665	602	591	594	602	602	
				584	648	675	666	603	592	595	603	603	
				585	649	676	667	604	593	596	604	604	
				586	650	677	668	605	594	597	605	605	
				587	651	678	669	606	595	598	606	606	
				588	652	679	670	607	596	599	607	607	
				589	653	680	671	608	597	600	608	608	
				590	654	681	672	609	598	601	609	609	
				591	655	682	673	610	599	602	610	610	
				592	656	683	674	611	600	603	611	611	
				593	657	684	675	612	601	604	612	612	
				594	658	685	676	613	602	605	613	613	
				595	659	686	677	614	603	606	614	614	
				596	660	687	678	615	604	607	615	615	
				597	661	688	679	616	605	608	616	616	
				598	662	689	680	617	606	609	617	617	
				599	663	690	681	618	607	610	618	618	
				600	664	691	682	619	608	611	619	619	
				601	665	692	683	620	609	612	620	620	
				602	666	693	684	621	610	613	621	621	
				603	667	694	685	622	611	614	622	622	
				604	668	695	686	623	612	615	623	623	
				605	669	696	687	624	613	616	624	624	
				606	670	697	688	625	614	617	625	625	
				607	671	698	689	626	615	618	626	626	
				608	672	699	690	627	616	619	627	627	
				609	673	700	691	628	617	620	628	628	
				610	674	701	692	629	618	621	629	629	
				611	675	702	693	630	619	622	630	630	
				612	676	703	694	631	620	623	631	631	
				613	677	704	695	632	621	624	632	632	
				614	678	705	696	633	622	625	633	633	
				615	679	706	697	634	623	626	634	634	
				616	680	707	698	635	624	627	635	635	
				617	681	708	699	636	625	628	636	636	
				618	682	709	700	637	626	629	637	637	
				619	683	710	701	638	627	630	638	638	
				620	684	711	702	639	628	631	639	639	
				621	685	712	703	640	629	632	640	640	
				622	686	713	704	641	630	633	641	641	
				623	687	714	705	642	631	634	642	642	
				624	688	715	706	643	632	635	643	643	
				625	689	716	707	644	633	636	644	644	
				626	690	717	708	645	634	637	645	645	
				627	691	718	709	646	635	638	646	646	
				628	692	719	710	647	636	639	647	647	
				629	693	720	711	648	637	640	648	648	
				630	694	721	712	649	638	641	649	649	
				631	695	722	713	650	639	642	650	650	
				632	696	723	714	651	640	643	651	651	
				633	697	724	715	652	641	644	652	652	
				634	698	725	716	653	642	645	653	653	
				635	699	726	717	654	643	646	654	654	
				636	700	727	718	655	644	647	655	655	
				637	701	728	719	656	645	648	656	656	
				638	702	729	720	657	646	649	657	657	
				639	703	730	721	658	647	650	658	658	
				640	704	731	722	659	648	651	659	659	
				641	705	732	723	660	649	652	660	660	
				642	706	733	724	661	650	653	661	661	
				643	707	734	725	662	651	654	662	662	
				644	708	735	726	663	652	655	663	663	
				645	709	736	727	664	653	656	664	664	
				646	710	737	728	665	654	657	665	665	
				647	711	738	729	666	655	658	666	666	
				648	712	739	730	667	656	659	667	667	
				649	713	740	731	668	657	660	668	668	
				650	714	741	732	669	658				

ELEN ANT TYP REL				MODES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
244	2	2	2	328	346	362	378	394	410	426	442	458	474	490	506	522	538	554	570	586	602	618	634	650	666	682	698	714	730	746	762	778	794	810	826	842	858	874	890	906	922	938	954	970	986	1002	1018	1034	1050	1066	1082	1098	1114	1130	1146	1162	1178	1194	1210	1226	1242	1258	1274	1290	1306	1322	1338	1354	1370	1386	1402	1418	1434	1450	1466	1482	1498	1514	1530	1546	1562	1578	1594	1610	1626	1642	1658	1674	1690	1706	1722	1738	1754	1770	1786	1802	1818	1834	1850	1866	1882	1898	1914	1930	1946	1962	1978	1994	2010	2026	2042	2058	2074	2090	2106	2122	2138	2154	2170	2186	2202	2218	2234	2250	2266	2282	2298	2314	2330	2346	2362	2378	2394	2410	2426	2442	2458	2474	2490	2506	2522	2538	2554	2570	2586	2602	2618	2634	2650	2666	2682	2698	2714	2730	2746	2762	2778	2794	2810	2826	2842	2858	2874	2890	2906	2922	2938	2954	2970	2986	3002	3018	3034	3050	3066	3082	3098	3114	3130	3146	3162	3178	3194	3210	3226	3242	3258	3274	3290	3306	3322	3338	3354	3370	3386	3402	3418	3434	3450	3466	3482	3498	3514	3530	3546	3562	3578	3594	3610	3626	3642	3658	3674	3690	3706	3722	3738	3754	3770	3786	3802	3818	3834	3850	3866	3882	3898	3914	3930	3946	3962	3978	3994	4010	4026	4042	4058	4074	4090	4106	4122	4138	4154	4170	4186	4202	4218	4234	4250	4266	4282	4298	4314	4330	4346	4362	4378	4394	4410	4426	4442	4458	4474	4490	4506	4522	4538	4554	4570	4586	4602	4618	4634	4650	4666	4682	4698	4714	4730	4746	4762	4778	4794	4810	4826	4842	4858	4874	4890	4906	4922	4938	4954	4970	4986	5002	5018	5034	5050	5066	5082	5098	5114	5130	5146	5162	5178	5194	5210	5226	5242	5258	5274	5290	5306	5322	5338	5354	5370	5386	5402	5418	5434	5450	5466	5482	5498	5514	5530	5546	5562	5578	5594	5610	5626	5642	5658	5674	5690	5706	5722	5738	5754	5770	5786	5802	5818	5834	5850	5866	5882	5898	5914	5930	5946	5962	5978	5994	6010	6026	6042	6058	6074	6090	6106	6122	6138	6154	6170	6186	6202	6218	6234	6250	6266	6282	6298	6314	6330	6346	6362	6378	6394	6410	6426	6442	6458	6474	6490	6506	6522	6538	6554	6570	6586	6602	6618	6634	6650	6666	6682	6698	6714																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
246	2	2	2	330	348	364	380	396	412	428	444	460	476	492	508	524	540	556	572	588	604	620	636	652	668	684	700	716	732	748	764	780	796	812	828	844	860	876	892	908	924	940	956	972	988	1004	1020	1036	1052	1068	1084	1100	1116	1132	1148	1164	1180	1196	1212	1228	1244	1260	1276	1292	1308	1324	1340	1356	1372	1388	1404	1420	1436	1452	1468	1484	1500	1516	1532	1548	1564	1580	1596	1612	1628	1644	1660	1676	1692	1708	1724	1740	1756	1772	1788	1804	1820	1836	1852	1868	1884	1900	1916	1932	1948	1964	1980	1996	2012	2028	2044	2060	2076	2092	2108	2124	2140	2156	2172	2188	2204	2220	2236	2252	2268	2284	2300	2316	2332	2348	2364	2380	2396	2412	2428	2444	2460	2476	2492	2508	2524	2540	2556	2572	2588	2604	2620	2636	2652	2668	2684	2700	2716	2732	2748	2764	2780	2796	2812	2828	2844	2860	2876	2892	2908	2924	2940	2956	2972	2988	3004	3020	3036	3052	3068	3084	3100	3116	3132	3148	3164	3180	3196	3212	3228	3244	3260	3276	3292	3308	3324	3340	3356	3372	3388	3404	3420	3436	3452	3468	3484	3500	3516	3532	3548	3564	3580	3596	3612	3628	3644	3660	3676	3692	3708	3724	3740	3756	3772	3788	3804	3820	3836	3852	3868	3884	3900	3916	3932	3948	3964	3980	3996	4012	4028	4044	4060	4076	4092	4108	4124	4140	4156	4172	4188	4204	4220	4236	4252	4268	4284	4300	4316	4332	4348	4364	4380	4396	4412	4428	4444	4460	4476	4492	4508	4524	4540	4556	4572	4588	4604	4620	4636	4652	4668	4684	4700	4716	4732	4748	4764	4780	4796	4812	4828	4844	4860	4876	4892	4908	4924	4940	4956	4972	4988	5004	5020	5036	5052	5068	5084	5100	5116	5132	5148	5164	5180	5196	5212	5228	5244	5260	5276	5292	5308	5324	5340	5356	5372	5388	5404	5420	5436	5452	5468	5484	5500	5516	5532	5548	5564	5580	5596	5612	5628	5644	5660	5676	5692	5708	5724	5740	5756	5772	5788	5804	5820	5836	5852	5868	5884	5900	5916	5932	5948	5964	5980	5996	6012	6028	6044	6060	6076	6092	6108	6124	6140	6156	6172	6188	6204	6220	6236	6252	6268	6284	6300	6316	6332	6348	6364	6380	6396	6412	6428	6444	6460	6476	6492	6508	6524	6540	6556	6572	6588	6604	6620	6636	6652	6668	6684	6700	6716	6732	6748	6764	6780	6796	6812	6828	6844	6860	6876	6892	6908	6924	6940	6956	6972	6988	7004	7020	7036	7052	7068	7084	7100	7116	7132	7148	7164	7180	7196	7212	7228	7244	7260	7276	7292	7308	7324	7340	7356	7372	7388	7404	7420	7436	7452	7468	7484	7500	7516	7532	7548	7564	7580	7596	7612	7628	7644	7660	7676	7692	7708	7724	7740	7756	7772	7788	7804	7820	7836	7852	7868	7884	7900	7916	7932	7948	7964	7980	7996	8012	8028	8044	8060	8076	8092	8108	8124	8140	8156	8172	8188	8204	8220	8236	8252	8268	8284	8300	8316	8332	8348	8364	8380	8396	8412	8428	8444	8460	8476	8492	8508	8524	8540	8556	8572	8588	8604	8620	8636	8652	8668	8684	8700	8716	8732	8748	8764	8780	8796	8812	8828	8844	8860	8876	8892	8908	8924	8940	8956	8972	8988	9004	9020	9036	9052	9068	9084	9100	9116	9132	9148	9164	9180	9196	9212	9228	9244	9260	9276	9292	9308	9324	9340	9356	9372	9388	9404	9420	9436	9452	9468	9484	9500	9516	9532	9548	9564	9580	9596	9612	9628	9644	9660	9676	9692	9708	9724	9740	9756	9772	9788	9804	9820	9836	9852	9868	9884	9900	9916	9932	9948	9964	9980	9996	10012	10028	10044	10060	10076	10092	10108	10124	10140	10156	10172	10188	10204	10220	10236	10252	10268	10284	10300	10316	10332	10348	10364	10380	10396	10412	10428	10444	10460	10476	10492	10508	10524	10540	10556	10572	10588	10604	10620	10636	10652	10668	10684	10700	10716	10732	10748	10764	10780	10796	10812	10828	10844	10860	10876	10892	10908	10924	10940	10956	10972	10988	11004	11020	11036	11052	11068	11084	11100	11116	11132	11148	11164	11180	11196	11212	11228	11244	11260	11276	11292	11308	11324	11340	11356	11372	11388	11404	11420	11436	11452	11468	11484	11500	11516	11532	11548	11564	11580	11596	11612	11628	11644	11660	11676	11692	11708	11724	11740	11756	11772	11788	11804	11820	11836	11852	11868	11884	11900	11916	11932	11948	11964	11980	11996	12012	12028	12044	12060	12076	12092	12108	12124	12140	12156	12172	12188	12204	12220	12236	12252	12268	12284	12300	12316	12332	12348	12364	12380	12396	12412	12428	12444	12460	12476	12492	12508	12524	12540	12556	12572	12588	12604	12620	12636	12652	12668	12684	12700	12716	12732	12748	12764	12780	12796	12812	12828	12844	12860	12876	12892	12908	12924	12940	12956	12972	12988	13004	13020	13036	13052	13068	13084	13100	13116	13132	13148	13164	13180	13196	13212	13228	13244	13260	13276	13292	13308	13324	13340	13356	13372	13388	13404	13420	13436	13452	13468	13484	13500	13516	13532	13548	13564	13580	13596	13612	13628	13644	13660	13676	13692	13708	13724	13740	13756	13772	13788	13804	13820	13836	13852	13868	13884	13900	13916	13932	13948	13964	13980	13996	14012	14028	14044	14060	14076	14092	14108	14124	14140	14156	14172	14188	14204	14220	14236	14252	14268	14284	14300	14316	14332	14348	14364	14380	14396	14412	14428	14444	14460	14476	14492	14508	14524	14540	14556	14572	14588	14604	14620	14636	14652	14668	14684	14700	14716	14732	14748	14764	14780	14796	14812	14828	14844	14860	14876	14892	14908	14924	14940	14956	14972	14988	15004	15020	15036	15052	15068	15084	15100	15116	15132	15148	15164	15180	15196	15212	15228	15244	15260	15276	15292	15308	15324	15

ELLEN	MAT	Typ	REL	MODES
251	2	2	2	540 582 600 608 640 716 558 540 584
252	2	2	2	541 583 601 609 641 716 559 541 585
253	3	2	2	551 586 611 608 646 716 564 551 588
254	3	2	2	552 587 612 609 647 717 565 552 589
255	3	2	2	553 588 613 610 648 718 566 553 590
256	2	2	2	554 589 614 611 649 719 567 554 591
257	1	1	1	555 590 615 612 650 720 568 555 592
258	1	1	1	556 591 616 613 651 721 569 556 593
259	3	2	2	557 592 617 614 652 722 570 557 594
260	3	2	2	558 593 618 615 653 723 571 558 595
261	3	2	2	559 594 619 616 654 724 572 559 596
262	3	2	2	560 595 620 617 655 725 573 560 597
263	3	2	2	561 596 621 618 656 726 574 561 598
264	3	2	2	562 597 622 619 657 727 575 562 599
265	3	2	2	563 598 623 620 658 728 576 563 600
266	3	2	2	564 599 624 621 659 729 577 564 601
267	3	2	2	565 600 625 622 660 730 578 565 602
268	3	2	2	566 601 626 623 661 731 579 566 603
269	3	2	2	567 602 627 624 662 732 580 567 604
270	3	2	2	568 603 628 625 663 733 581 568 605
271	3	2	2	569 604 629 626 664 734 582 569 606
272	3	2	2	570 605 630 627 665 735 583 570 607
273	3	2	2	571 606 631 628 666 736 584 571 608
274	3	2	2	572 607 632 629 667 737 585 572 609
275	3	2	2	573 608 633 630 668 738 586 573 610
276	3	2	2	574 609 634 631 669 739 587 574 611
277	3	2	2	575 610 635 632 670 740 588 575 612
278	3	2	2	576 611 636 633 671 741 589 576 613
279	3	2	2	577 612 637 634 672 742 590 577 614
280	3	2	2	578 613 638 635 673 743 591 578 615
281	3	2	2	579 614 639 636 674 744 592 579 616
282	3	2	2	580 615 640 637 675 745 593 580 617
283	3	2	2	581 616 641 638 676 746 594 581 618
284	3	2	2	582 617 642 639 677 747 595 582 619
285	3	2	2	583 618 643 640 678 748 596 583 620
286	3	2	2	584 619 644 641 679 749 597 584 621
287	3	2	2	585 620 645 642 680 750 598 585 622
288	3	2	2	586 621 646 643 681 751 599 586 623
289	3	2	2	587 622 647 644 682 752 600 587 624
290	3	2	2	588 623 648 645 683 753 601 588 625
291	3	2	2	589 624 649 646 684 754 602 589 626
292	3	2	2	590 625 650 647 685 755 603 590 627
293	3	2	2	591 626 651 648 686 756 604 591 628
294	3	2	2	592 627 652 649 687 757 605 592 629
295	3	2	2	593 628 653 650 688 758 606 593 630
296	3	2	2	594 629 654 651 689 759 607 594 631
297	3	2	2	595 630 655 652 690 760 608 595 632
298	3	2	2	596 631 656 653 691 761 609 596 633
299	3	2	2	597 632 657 654 692 762 610 597 634
300	3	2	2	598 633 658 655 693 763 611 598 635
301	3	2	2	599 634 659 656 694 764 612 599 636
302	3	2	2	600 635 660 657 695 765

ELLEN MAT TYP REL				NODES									
227	2	2	2	845	547	549	547	527	529	549	544	544	
				846	548	550	548	528	530	550	545	545	
228	2	2	2	537	548	539	548	523	545	547	545	544	
				538	549	537	549	524	546	548	546	544	
229	2	2	2	461	543	496	484	547	539	542	540		
				462	544	497	495	548	540	543	540	561	
230	2	2	2	547	539	538	548	548	539	544	542		
				548	540	539	540	549	546	544	554		
231	2	2	2	553	536	534	548	545	537	539	536		
				554	537	535	549	546	548	548	548		
232	2	2	2	557	537	538	547	547	537	537	548		
				558	538	539	548	548	538	548	548		
233	2	2	2	727	729	729	729	727	729	729	729		
				728	730	730	730	728	730	730	730		
234	2	2	2	413	413	413	413	413	413	413	413		
				414	414	414	414	414	414	414	414		
235	2	2	2	683	683	683	683	683	683	683	683		
				684	684	684	684	684	684	684	684		
236	2	2	2	823	823	823	823	823	823	823	823		
				824	824	824	824	824	824	824	824		
237	2	2	2	691	691	691	691	691	691	691	691		
				692	692	692	692	692	692	692	692		
238	2	2	2	817	817	817	817	817	817	817	817		
				818	818	818	818	818	818	818	818		
239	2	2	2	827	827	827	827	827	827	827	827		
				828	828	828	828	828	828	828	828		
240	2	2	2	837	837	837	837	837	837	837	837		
				838	838	838	838	838	838	838	838		
241	2	2	2	860	860	860	860	860	860	860	860		
				861	861	861	861	861	861	861	861		
242	2	2	2	861	861	861	861	861	861	861	861		
				862	862	862	862	862	862	862	862		
243	2	2	2	862	862	862	862	862	862	862	862		
				863	863	863	863	863	863	863	863		
244	2	2	2	332	332	332	332	332	332	332	332		
				333	333	333	333	333	333	333	333		
245	2	2	2	334	334	334	334	334	334	334	334		
				335	335	335	335	335	335	335	335		
246	2	2	2	372	414	432	366	374	416	434	382	386	
				373	415	433	391	376	417	435	384	388	
246	2	2	2	429	413	414	394	377	412	420	394		
				430	414	415	395	383	413	421	396		
247	2	2	2	376	413	430	368	384	458	516	474	476	
				377	414	431	369	385	459	517	475	477	
248	2	2	2	458	488	518	474	458	508	518	476	476	
				459	489	519	475	459	509	519	477	477	
248	2	2	2	487	495	515	472	487	497	515	480	480	
				488	496	516	473	488	498	516	481	481	
249	2	2	2	488	528	518	478	488	538	518	478	478	
				489	529	519	479	489	539	519	479	479	
250	2	2	2	454	484	514	478	548	508	548	548	548	
				455	485	515	479	549	509	549	549	549	
ELLEN MAT TYP REL				NODES									
251	2	2	2	548	558	558	558	542	584	584	554	554	
				549	559	559	559	543	585	585	555	555	
252	2	2	2	549	559	559	559	544	586	586	556	556	
				550	560	560	560	545	587	587	557	557	
253	2	2	2	722	722	722	722	722	722	722	722	722	
				723	723	723	723	723	723	723	723	723	
254	2	2	2	736	736	736	736	736	736	736	736	736	
				737	737	737	737	737	737	737	737	737	
255	2	2	2	2601	2601	2601	2601	2601	2601	2601	2601	2601	
				2602	2602	2602	2602	2602	2602	2602	2602	2602	
256	2	2	2	2601	2601	2601	2601	2601	2601	2601	2601	2601	
				2602	2602	2602	2602	2602	2602	2602	2602	2602	
257	1	1	1	2604	2604	2604	2604	2604	2604	2604	2604	2604	
				2605	2605	2605	2605	2605	2605	2605	2605	2605	

1137 SUBJECTS (LEADS, IN RANGE 400 TO 600 BY 1 (1137 MODES)

ELER MAT TYP REL	MODES	NO OF CONTINUOUS
000	1	1
001	1	1
002	1	1
003	1	1
004	1	1
005	1	1
006	1	1
007	1	1
008	1	1
009	1	1
010	1	1
011	1	1
012	1	1
013	1	1
014	1	1
015	1	1
016	1	1
017	1	1
018	1	1
019	1	1
020	1	1
021	1	1
022	1	1
023	1	1
024	1	1
025	1	1
026	1	1
027	1	1
028	1	1
029	1	1
030	1	1
031	1	1
032	1	1
033	1	1
034	1	1
035	1	1
036	1	1
037	1	1
038	1	1
039	1	1
040	1	1
041	1	1
042	1	1
043	1	1
044	1	1
045	1	1
046	1	1
047	1	1
048	1	1
049	1	1
050	1	1
051	1	1
052	1	1
053	1	1
054	1	1
055	1	1
056	1	1
057	1	1
058	1	1
059	1	1
060	1	1
061	1	1
062	1	1
063	1	1
064	1	1
065	1	1
066	1	1
067	1	1
068	1	1
069	1	1
070	1	1
071	1	1
072	1	1
073	1	1
074	1	1
075	1	1
076	1	1
077	1	1
078	1	1
079	1	1
080	1	1
081	1	1
082	1	1
083	1	1
084	1	1
085	1	1
086	1	1
087	1	1
088	1	1
089	1	1
090	1	1
091	1	1
092	1	1
093	1	1
094	1	1
095	1	1
096	1	1
097	1	1
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099	1	1
100	1	1
101	1	1
102	1	1
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104	1	1
105	1	1
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111	1	1
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134	1	1
135	1	1
136	1	1
137	1	1
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139	1	1
140	1	1
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156	1	1
157	1	1
158	1	1
159	1	1
160	1	1
161	1	1
162	1	1
163	1	1
164	1	1
165	1	1
166	1	1
167	1	1
168	1	1
169	1	1
170	1	1
171	1	1
172	1	1
173	1	1
174	1	1
175	1	1
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179	1	1
180	1	1
181	1	1
182	1	1
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184	1	1
185	1	1
186	1	1
187	1	1
188	1	1
189	1	1
190	1	1
191	1	1
192	1	1
193	1	1
194	1	1
195	1	1
196	1	1
197	1	1
198	1	1
199	1	1
200	1	1

420 1 1 2542 25
MODE 1 YES, NO OR CONTINUOUS).

CLER	POS	TYP	REL	MODES
481	1	1	1	2645
482	1	1	1	2646
483	1	1	1	2647
484	1	1	1	2648
485	1	1	1	2649
486	1	1	1	2650
487	1	1	1	2651
488	1	1	1	2652
489	1	1	1	2653
490	1	1	1	2654
491	1	1	1	2655
492	1	1	1	2656
493	1	1	1	2657
494	1	1	1	2658
495	1	1	1	2659
496	1	1	1	2660
497	1	1	1	2661
498	1	1	1	2662
499	1	1	1	2663
500	1	1	1	2664
501	1	1	1	2665
502	1	1	1	2666
503	1	1	1	2667
504	1	1	1	2668
505	1	1	1	2669
506	1	1	1	2670
507	1	1	1	2671
508	1	1	1	2672
509	1	1	1	2673
510	1	1	1	2674
511	1	1	1	2675
512	1	1	1	2676
513	1	1	1	2677
514	1	1	1	2678
515	1	1	1	2679
516	1	1	1	2680
517	1	1	1	2681
518	1	1	1	2682
519	1	1	1	2683
520	1	1	1	2684
521	1	1	1	2685
522	1	1	1	2686
523	1	1	1	2687
524	1	1	1	2688
525	1	1	1	2689
526	1	1	1	2690
527	1	1	1	2691
528	1	1	1	2692
529	1	1	1	2693
530	1	1	1	2694
531	1	1	1	2695
532	1	1	1	2696
533	1	1	1	2697
534	1	1	1	2698
535	1	1	1	2699
536	1	1	1	2700
537	1	1	1	2701
538	1	1	1	2702
539	1	1	1	2703
540	1	1	1	2704
541	1	1	1	2705
542	1	1	1	2706
543	1	1	1	2707
544	1	1	1	2708
545	1	1	1	2709
546	1	1	1	2710
547	1	1	1	2711
548	1	1	1	2712
549	1	1	1	2713
550	1	1	1	2714
551	1	1	1	2715
552	1	1	1	2716
553	1	1	1	2717
554	1	1	1	2718
555	1	1	1	2719
556	1	1	1	2720
557	1	1	1	2721
558	1	1	1	2722
559	1	1	1	2723
560	1	1	1	2724
561	1	1	1	2725
562	1	1	1	2726
563	1	1	1	2727
564	1	1	1	2728
565	1	1	1	2729
566	1	1	1	2730
567	1	1	1	2731
568	1	1	1	2732
569	1	1	1	2733
570	1	1	1	2734
571	1	1	1	2735
572	1	1	1	2736
573	1	1	1	2737
574	1	1	1	2738
575	1	1	1	2739
576	1	1	1	2740
577	1	1	1	2741
578	1	1	1	2742
579	1	1	1	2743
580	1	1	1	2744
581	1	1	1	2745

ELER	PMY	TPY	REL	MODES
439	1	1	1	2893
440	1	1	1	2894
441	1	1	1	2895
442	1	1	1	2896
443	1	1	1	2897
444	1	1	1	2898
445	1	1	1	2899
446	1	1	1	2900
447	1	1	1	2901
448	1	1	1	2902
449	1	1	1	2903
450	1	1	1	2904
451	1	1	1	2905
452	1	1	1	2906
453	1	1	1	2907
454	1	1	1	2908
455	1	1	1	2909
456	1	1	1	2910
457	1	1	1	2911
458	1	1	1	2912
459	1	1	1	2913
460	1	1	1	2914
461	1	1	1	2915
462	1	1	1	2916
463	1	1	1	2917
464	1	1	1	2918
465	1	1	1	2919
466	1	1	1	2920
467	2	2	2	2921
468	2	2	2	2922
469	2	2	2	2923
470	2	2	2	2924
471	2	2	2	2925
472	2	2	2	2926
473	2	2	2	2927
474	2	2	2	2928
475	2	2	2	2929
476	2	2	2	2930
477	2	2	2	2931
478	2	2	2	2932
479	2	2	2	2933
480	2	2	2	2934
481	2	2	2	2935
482	2	2	2	2936
483	2	2	2	2937
484	2	2	2	2938
485	2	2	2	2939
486	2	2	2	2940
487	2	2	2	2941
488	2	2	2	2942
489	2	2	2	2943
490	2	2	2	2944
491	2	2	2	2945
492	2	2	2	2946
493	2	2	2	2947
494	2	2	2	2948
495	2	2	2	2949
496	2	2	2	2950
497	2	2	2	2951
498	2	2	2	2952
499	2	2	2	2953
500	2	2	2	2954
501	2	2	2	2955
502	2	2	2	2956
503	2	2	2	2957
504	2	2	2	2958
505	2	2	2	2959
506	2	2	2	2960
507	2	2	2	2961
508	2	2	2	2962
509	2	2	2	2963
510	2	2	2	2964
511	2	2	2	2965
512	2	2	2	2966
513	2	2	2	2967
514	2	2	2	2968
515	2	2	2	2969
516	2	2	2	2970
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518	2	2	2	2972
519	2	2	2	2973
520	2	2	2	2974
521	2	2	2	2975
522	2	2	2	2976
523	2	2	2	2977
524	2	2	2	2978
525	2	2	2	2979
526	2	2	2	2980
527	2	2	2	2981
528	2	2	2	2982
529	2	2	2	2983
530	2	2	2	2984
531	2	2	2	2985
532	2	2	2	2986
533	2	2	2	2987
534	2	2	2	2988
535	2	2	2	2989
536	2	2	2	2990
537	2	2	2	2991
538	2	2	2	2992
539	2	2	2	2993

ELER PMY TPY REL				NOSES							
456	2	2	2	2,415	2,487	2,481	2,432	2,534	2,576	2,587	2,526
				2,420	2,480	2,442	2,436	2,546	2,578	2,610	2,536
467	2	2	2	2,414	2,476	2,465	2,532	2,574	2,588	2,627	
				2,416	2,478	2,449	2,555	2,647	2,679	2,688	2,637
				2,445	2,478	2,448	2,548	2,556			
468	2	2	2	2,533	2,576	2,573	2,657	2,629	2,571	2,585	2,523
				2,532	2,574	2,569					

ELEM MAT TYP REL								NODES							
450	2	2	2	2	2	2	2	2847	2579	2650	2637	2646	2572	2648	2530
451	2	2	2	2	2	2	2	2848	2580	2651	2638	2647	2573	2649	2531
452	3	2	2	2	2	2	2	2849	2581	2652	2639	2648	2574	2650	2532
453	1	1	1	1	1	1	1	2850	2582	2653	2640	2649	2575	2651	2533
454	1	1	1	1	1	1	1	2851	2583	2654	2641	2650	2576	2652	2534
455	1	1	1	1	1	1	1	2852	2584	2655	2642	2651	2577	2653	2535
456	2	2	2	2	2	2	2	2853	2585	2656	2643	2652	2578	2654	2536
457	2	2	2	2	2	2	2	2854	2586	2657	2644	2653	2579	2655	2537
458	3	2	2	2	2	2	2	2855	2587	2658	2645	2654	2580	2656	2538
459	2	2	2	2	2	2	2	2856	2588	2659	2646	2655	2581	2657	2539
460	1	1	1	1	1	1	1	2857	2589	2660	2647	2656	2582	2658	2540
461	2	2	2	2	2	2	2	2858	2590	2661	2648	2657	2583	2659	2541
462	1	1	1	1	1	1	1	2859	2591	2662	2649	2658	2584	2660	2542
463	1	1	1	1	1	1	1	2860	2592	2663	2650	2659	2585	2661	2543
464	1	1	1	1	1	1	1	2861	2593	2664	2651	2660	2586	2662	2544
465	1	1	1	1	1	1	1	2862	2594	2665	2652	2661	2587	2663	2545
466	2	2	2	2	2	2	2	2863	2595	2666	2653	2662	2588	2664	2546
467	2	2	2	2	2	2	2	2864	2596	2667	2654	2663	2589	2665	2547
468	3	2	2	2	2	2	2	2865	2597	2668	2655	2664	2590	2666	2548
469	2	2	2	2	2	2	2	2866	2598	2669	2656	2665	2591	2667	2549
470	2	2	2	2	2	2	2	2867	2599	2670	2657	2666	2592	2668	2550
471	2	2	2	2	2	2	2	2868	2600	2671	2658	2667	2593	2669	2551
472	1	1	1	1	1	1	1	2869	2601	2672	2659	2668	2594	2670	2552
473	1	1	1	1	1	1	1	2870	2602	2673	2660	2669	2595	2671	2553
474	1	1	1	1	1	1	1	2871	2603	2674	2661	2670	2596	2672	2554
475	2	2	2	2	2	2	2	2872	2604	2675	2662	2671	2597	2673	2555

[illegible]

ALLEN UNIT	TYPE	WELL	MODEL	2387	2341	2340	2376	2357	2389	2421	2370
483	2	2	2	2632	2638	2676	2354	2637	2423	2461	2341
484	2	2	2	2356	2368	2434	2370	2619	2491	2422	2380
485	2	2	2	2637	2369	2421	2370	2618	2426	2432	2384
486	2	2	2	2358	2400	2487	2366	2356	2397	2419	2377
487	2	2	2	2359	2401	2428	2360	2356	2418	2426	2376
488	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
489	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
490	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
491	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
492	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
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494	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
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496	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
497	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
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499	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
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502	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
503	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
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512	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
513	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
514	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
515	2	2	2	2356	2408	2428	2362	2356	2418	2426	2376
516	2	2	2	2356	2408	2428	2362	2356	2418	2426</	

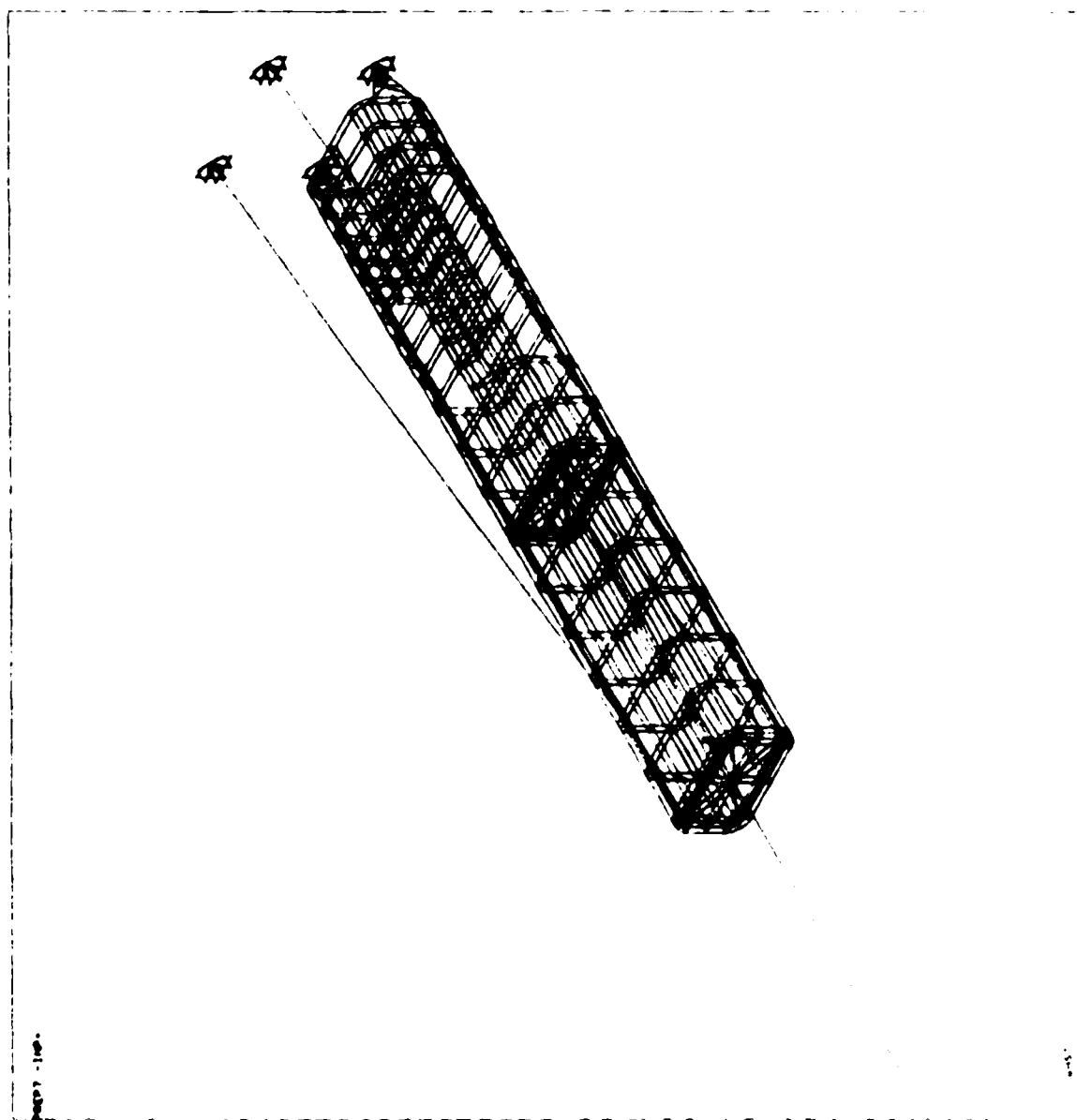
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[illegible][illegible]

[illegible]

LIST SELECTED MODES IN THE RANGE 4130 TO 4261 BY 1 DAYS- 0									
MODE	X	Y	Z	THY1	THY2	THY3	THY4	THY5	THY6
4130	18.000	-6.3500	10.632	0.00	0.00	0.00	0.00	0.00	0.00
4131	18.000	-6.3500	19.167	0.00	0.00	0.00	0.00	0.00	0.00
4132	18.000	-6.3500	27.750	0.00	0.00	0.00	0.00	0.00	0.00
4133	18.000	-6.3500	36.333	0.00	0.00	0.00	0.00	0.00	0.00
4134	18.000	-6.3500	44.917	0.00	0.00	0.00	0.00	0.00	0.00
4135	18.000	-6.3500	53.500	0.00	0.00	0.00	0.00	0.00	0.00
4136	18.000	-6.3500	62.083	0.00	0.00	0.00	0.00	0.00	0.00
4137	18.000	-6.3500	70.667	0.00	0.00	0.00	0.00	0.00	0.00
4138	18.000	-6.3500	79.250	0.00	0.00	0.00	0.00	0.00	0.00
4139	18.000	-6.3500	87.833	0.00	0.00	0.00	0.00	0.00	0.00
4140	18.000	-6.3500	96.417	0.00	0.00	0.00	0.00	0.00	0.00
4141	18.000	-6.3500	105.000	0.00	0.00	0.00	0.00	0.00	0.00
4142	18.000	-6.3500	113.583	0.00	0.00	0.00	0.00	0.00	0.00
4143	18.000	-6.3500	122.167	0.00	0.00	0.00	0.00	0.00	0.00
4144	18.000	-6.3500	130.750	0.00	0.00	0.00	0.00	0.00	0.00
4145	18.000	-6.3500	139.333	0.00	0.00	0.00	0.00	0.00	0.00
4146	18.000	-6.3500	147.917	0.00	0.00	0.00	0.00	0.00	0.00
4147	18.000	-6.3500	156.500	0.00	0.00	0.00	0.00	0.00	0.00
4148	18.000	-6.3500	165.083	0.00	0.00	0.00	0.00	0.00	0.00
4149	18.000	-6.3500	173.667	0.00	0.00	0.00	0.00	0.00	0.00
4150	18.000	-6.3500	182.250	0.00	0.00	0.00	0.00	0.00	0.00
4151	18.000	-6.3500	190.833	0.00	0.00	0.00	0.00	0.00	0.00
4152	18.000	-6.3500	199.417	0.00	0.00	0.00	0.00	0.00	0.00
4153	18.000	-6.3500	208.000	0.00	0.00	0.00	0.00	0.00	0.00
4154	18.000	-6.3500	216.583	0.00	0.00	0.00	0.00	0.00	0.00
4155	18.000	-6.3500	225.167	0.00	0.00	0.00	0.00	0.00	0.00
4156	18.000	-6.3500	233.750	0.00	0.00	0.00	0.00	0.00	0.00
4157	18.000	-6.3500	242.333	0.00	0.00	0.00	0.00	0.00	0.00
4158	18.000	-6.3500	250.917	0.00	0.00	0.00	0.00	0.00	0.00
4159	18.000	-6.3500	259.500	0.00	0.00	0.00	0.00	0.00	0.00
4160	18.000	-6.3500	268.083	0.00	0.00	0.00	0.00	0.00	0.00
4161	18.000	-6.3500	276.667	0.00	0.00	0.00	0.00	0.00	0.00
4162	18.000	-6.3500	285.250	0.00	0.00	0.00	0.00	0.00	0.00
4163	18.000	-6.3500	293.833	0.00	0.00	0.00	0.00	0.00	0.00
4164	18.000	-6.3500	302.417	0.00	0.00	0.00	0.00	0.00	0.00
4165	18.000	-6.3500	311.000	0.00	0.00	0.00	0.00	0.00	0.00
4166	18.000	-6.3500	319.583	0.00	0.00	0.00	0.00	0.00	0.00
4167	18.000	-6.3500	328.167	0.00	0.00	0.00	0.00	0.00	0.00
4168	18.000	-6.3500	336.750	0.00	0.00	0.00	0.00	0.	

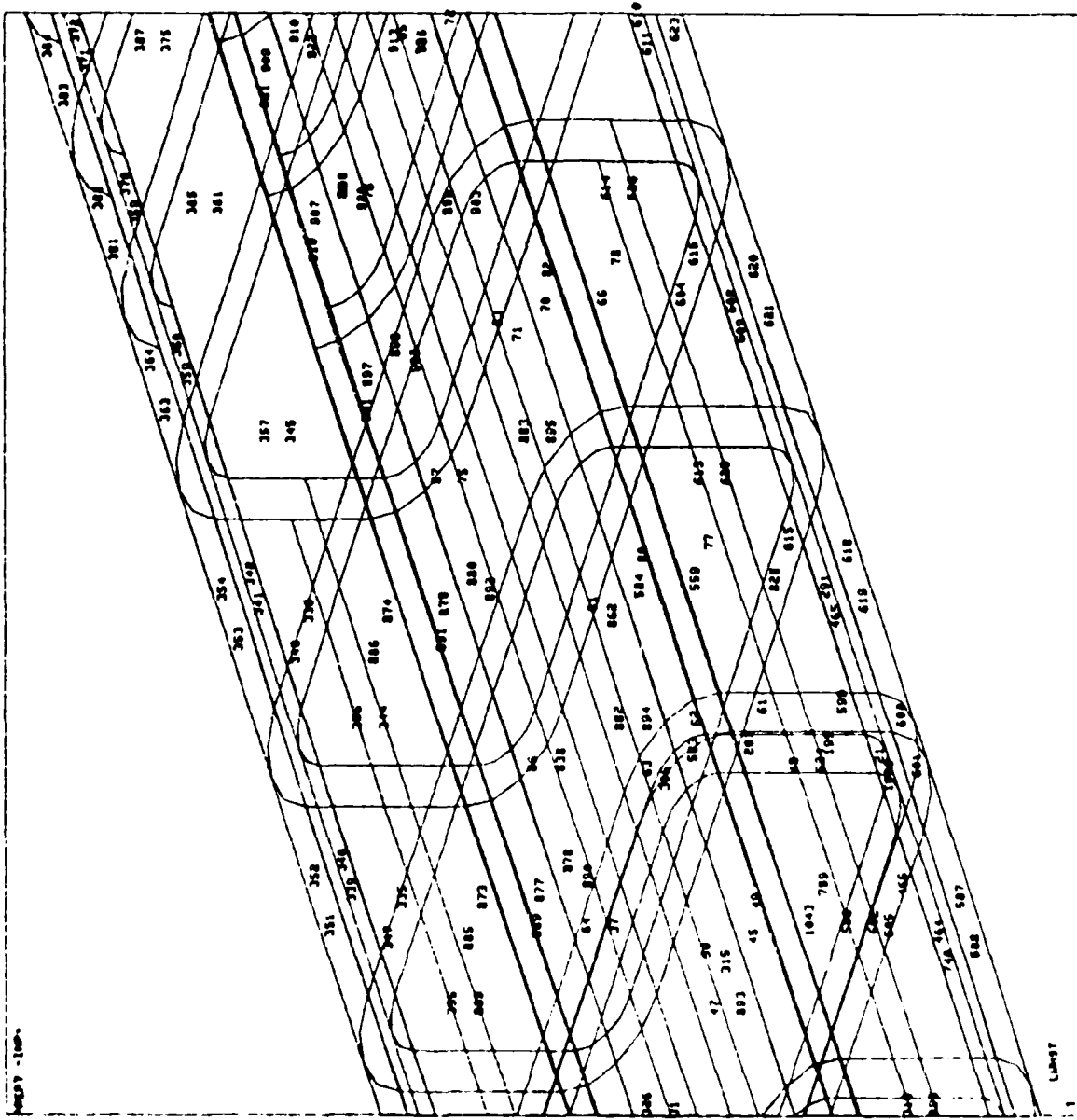
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 T200-1
 PBC-1
 200-1
 200-1
 200-1
 2157-102
 200-1-0.03
 200-11.7
 200-04.0



Page 7 - 100 -

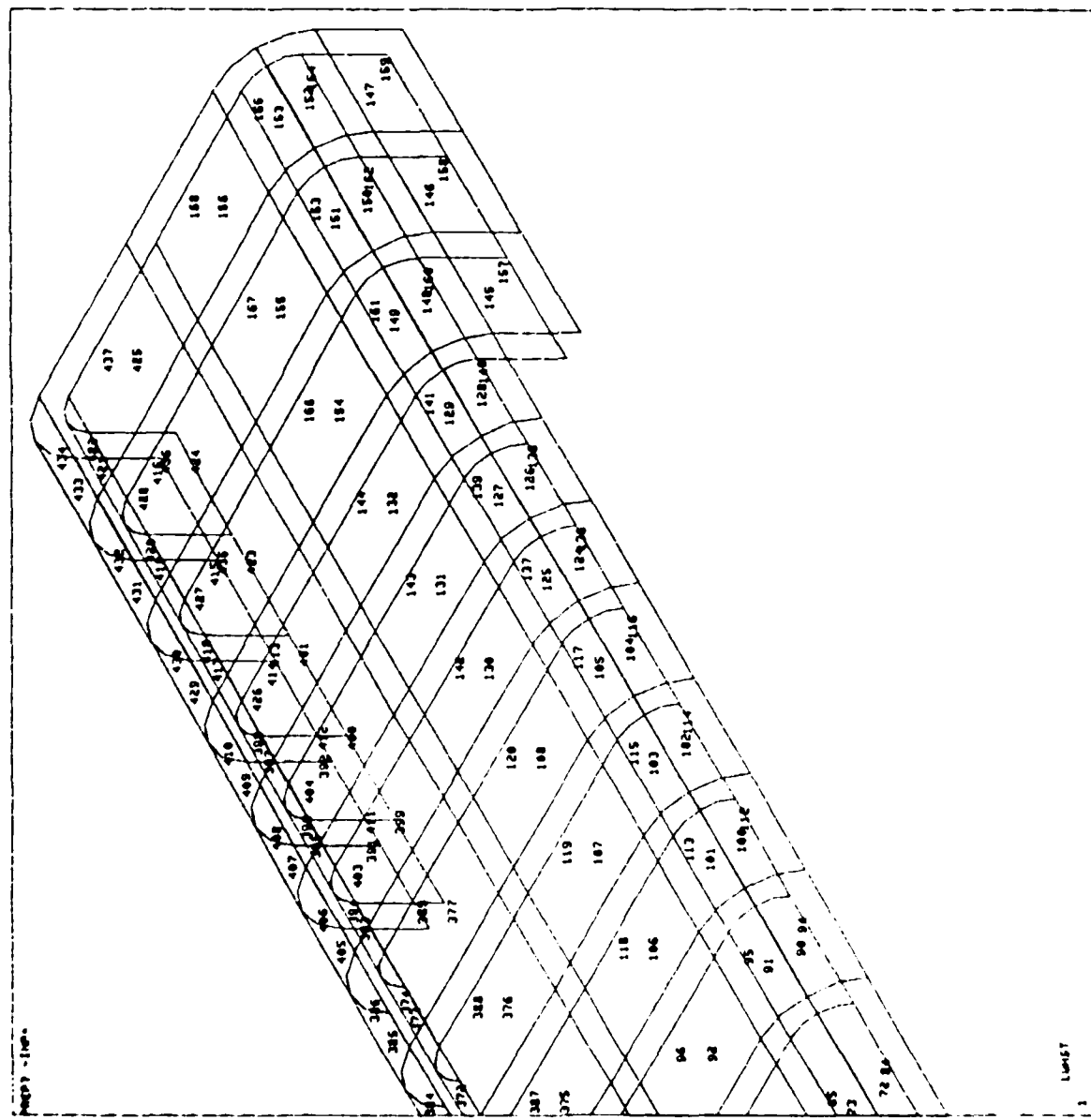
4

WMSV 4.00
NOV 13 1966
15:22:54
PREP7 ELEMENTZ
CASH-1
ZCOR
RUC-1
VUC-1
ZU-1
0157-25.6
AF-5.50
VF-4.60
ZF-126
ARFO-1.74



ATT

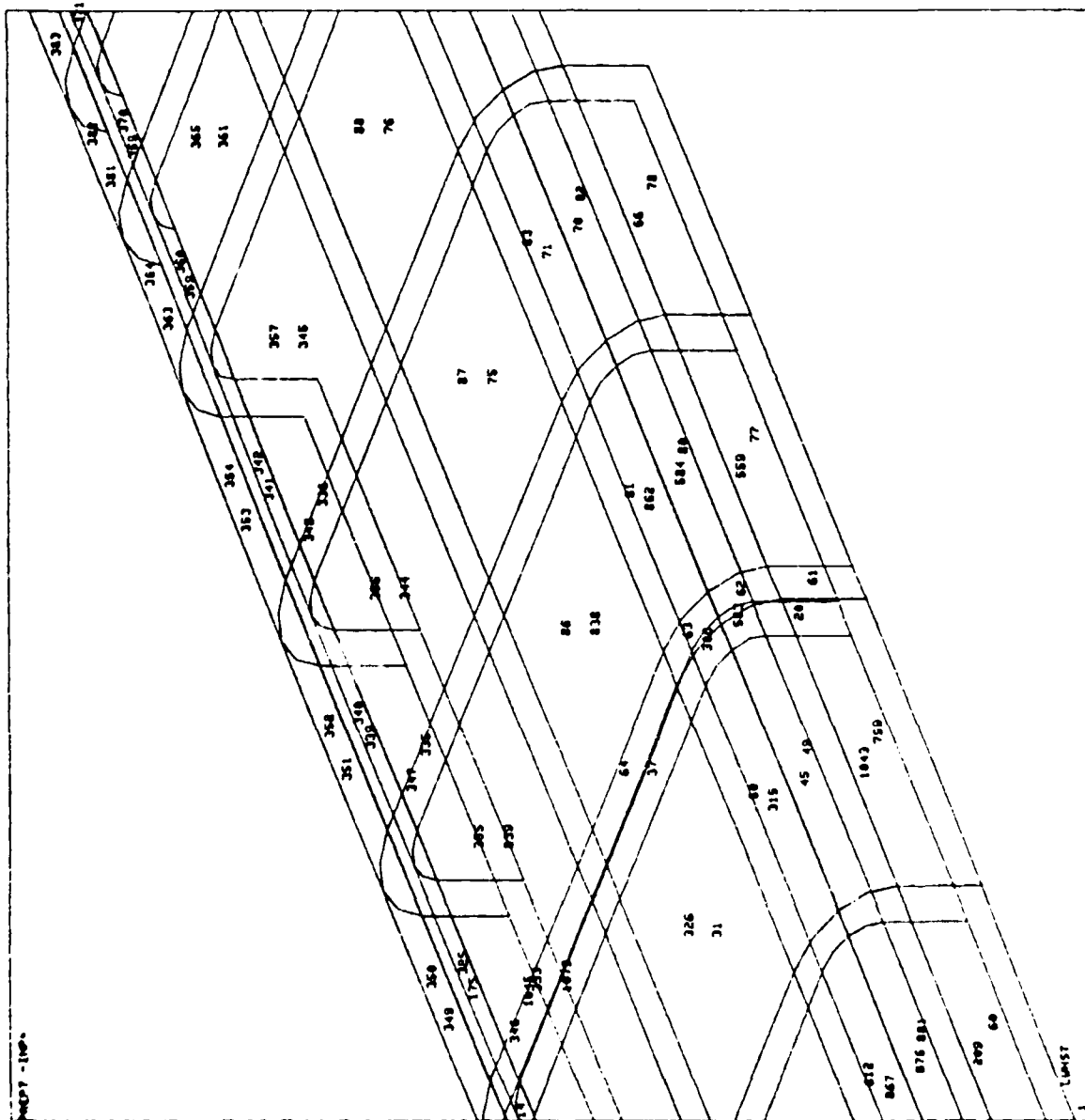
ANSYS 4.20
 NOV 13 1986
 15:28:31
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 ENUR-1
 ZOOM
 XU--1
 YU--1
 ZU--1
 0157-54.5
 107-22.2
 107-26.9
 207-172
 MPTO-1.72
 MPTO-1.75



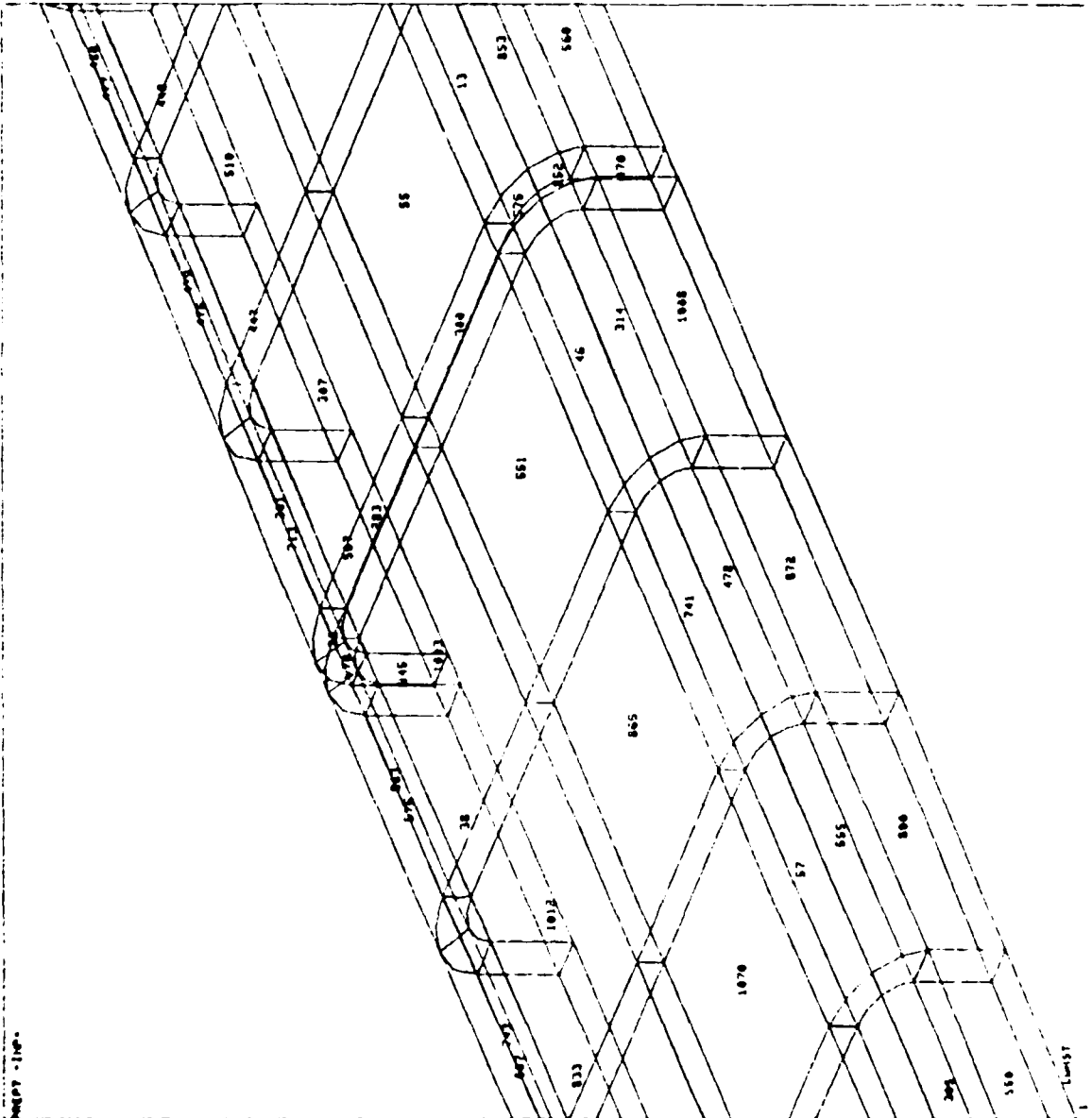
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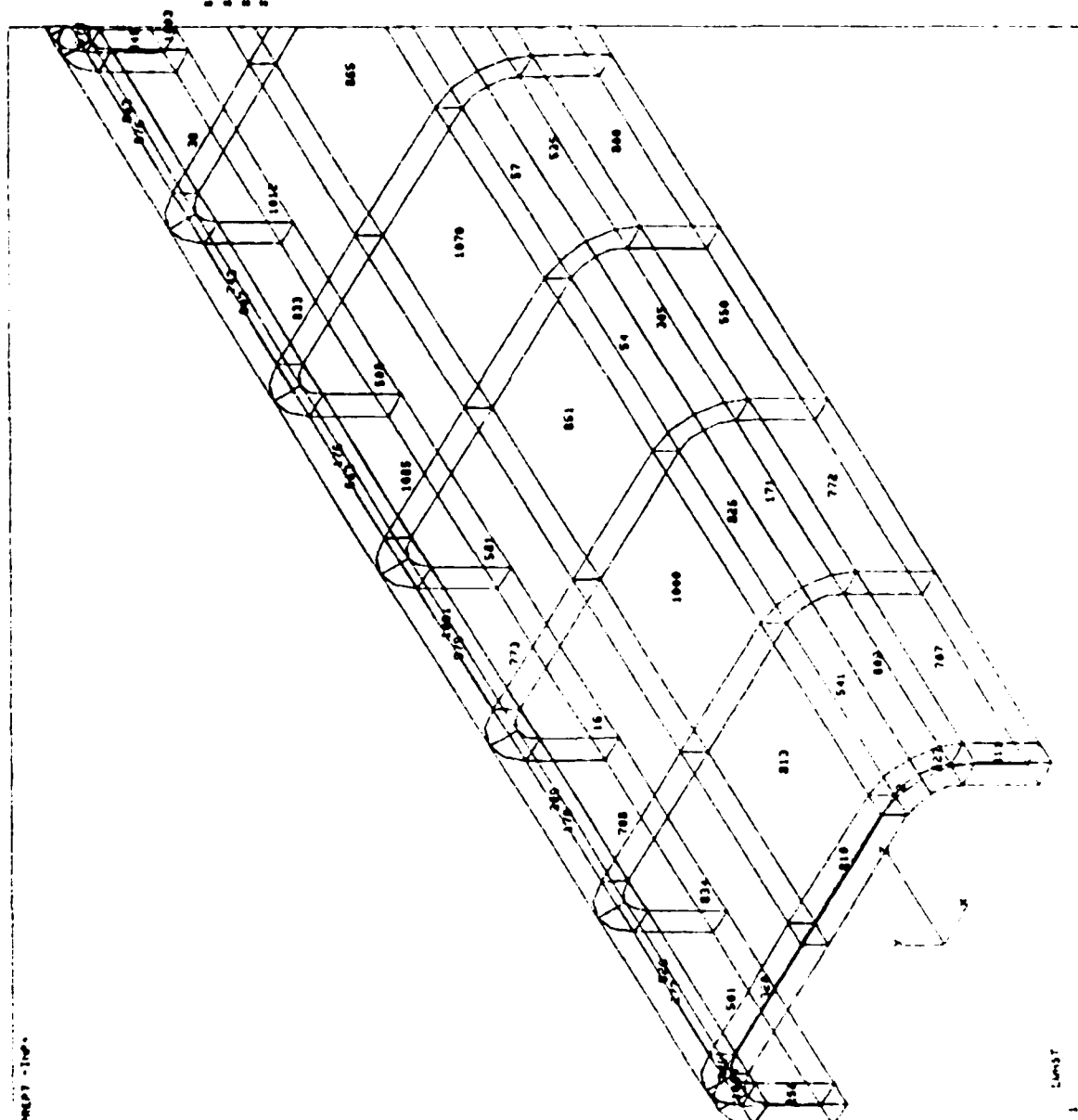
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15:28:46
PREP7 ELEMENTS
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ZOOM
NUM=1
WUM=1
ZUM=1
DIST=0.4
K1=3.07
K2=7.36
K3=1.22
K4=1.72
K5=1.22



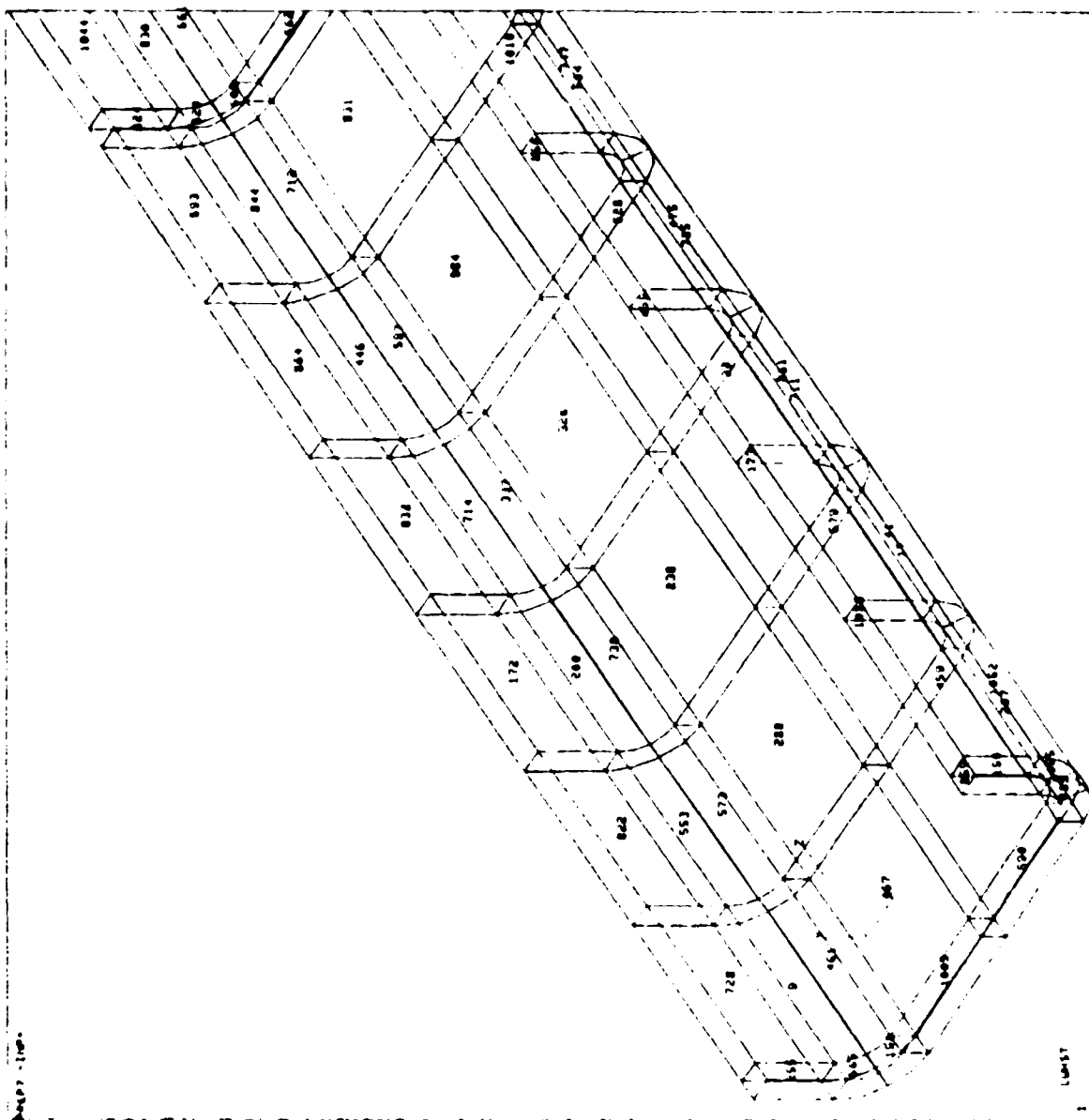
ANSV 4.23
 NOV 13 1988
 15:15:46
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 ENL=1
 ECOM
 RV=1
 VO=1
 EV=1
 DT=61.6
 ST=6.41
 VT=1.45
 EF=184
 RTG=8.34
 VATC=1.75



ANSYS 4.22
 NOV 13 1986
 15:47:27
 PREP7 ELEMENTS
 ENJO-1
 2008
 10--1
 70--1
 20-1
 8155-00.4
 4 10--25.3
 8 10--16
 2 20-66.1
 100-2.34
 100-2.55

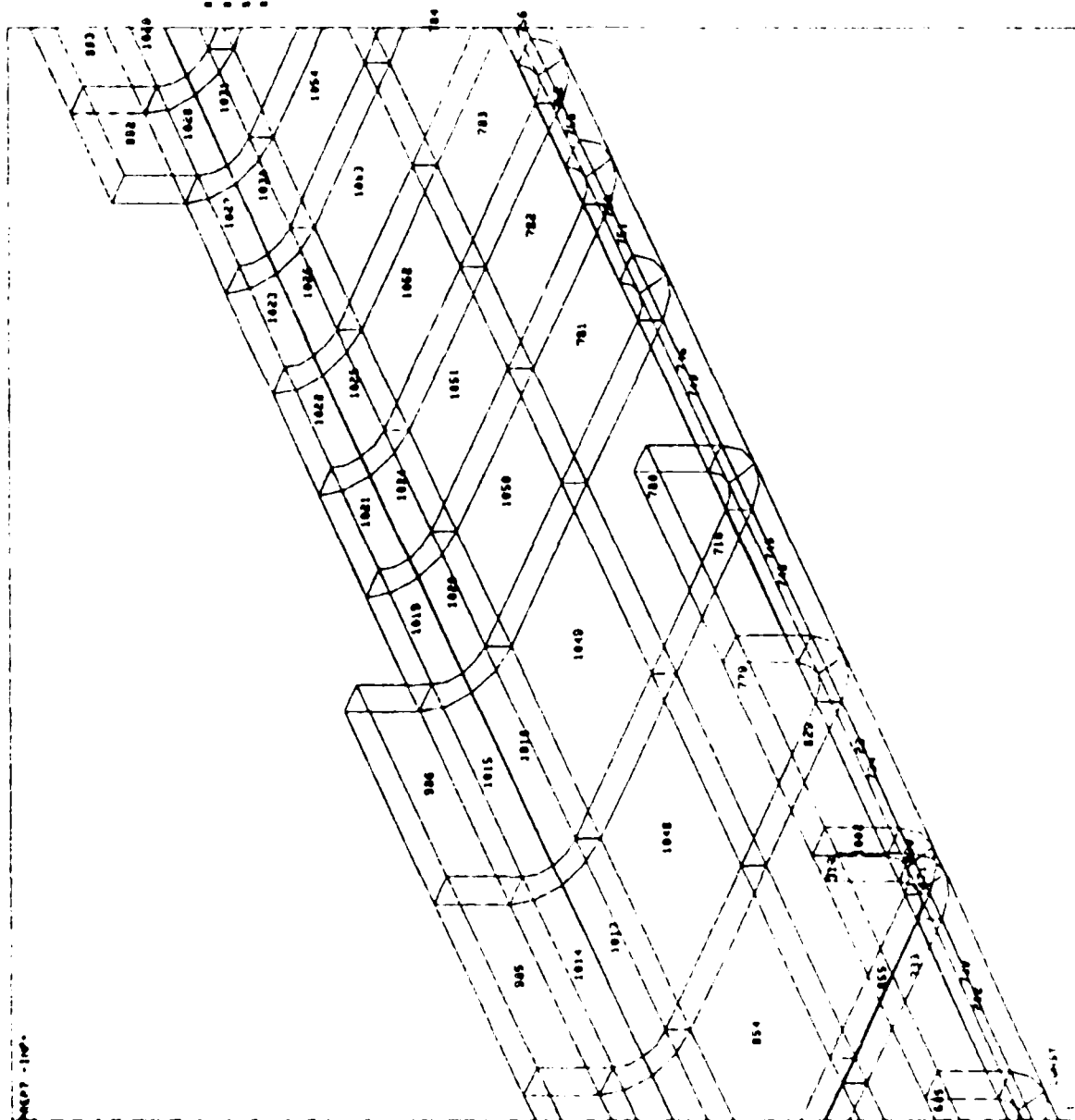


ANALYSIS 4.20
 NOV 13 1985
 15:54:07
 PREP7 ELEMENTS
 ENCL-1
 ZOOM
 XMIN=1
 XMAX=1
 YMIN=1
 YMAX=1
 ZMIN=1
 ZMAX=1
 RST=101
 RT=20
 VZ=23.8
 ZF=68.0
 RSTO=2.34
 VRTG=2.82

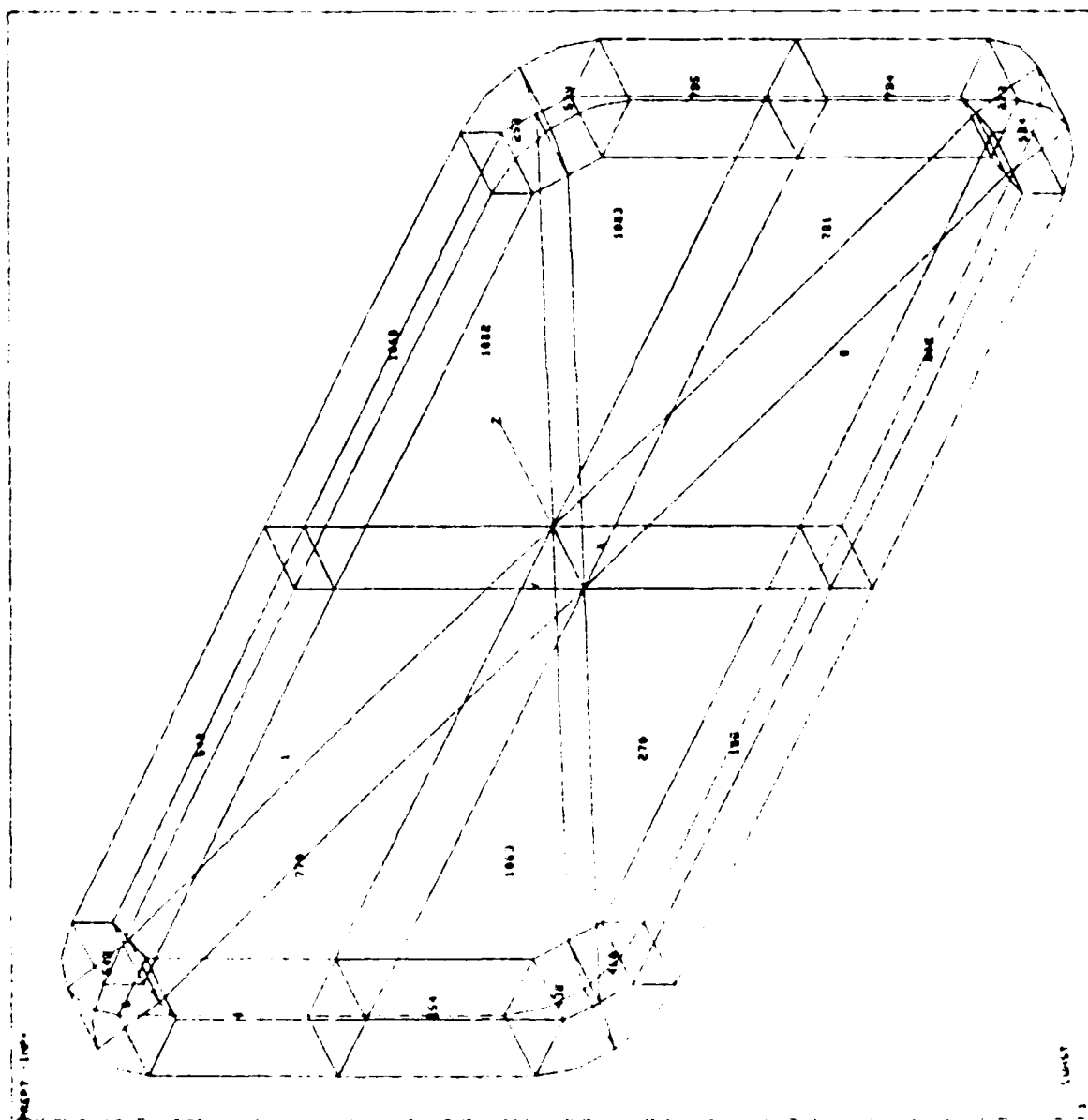


ANALYSIS 4.43
 NOV 13 1966
 1518117
 PROJECT ELEMENTS
 LINDA-1

200P
 R00-1
 P00-1
 Z00-1
 DIST-106
 AF-0.73
 VE-0.37
 27-1.36
 1810-2.48
 1810-2.82



Tr. Muller



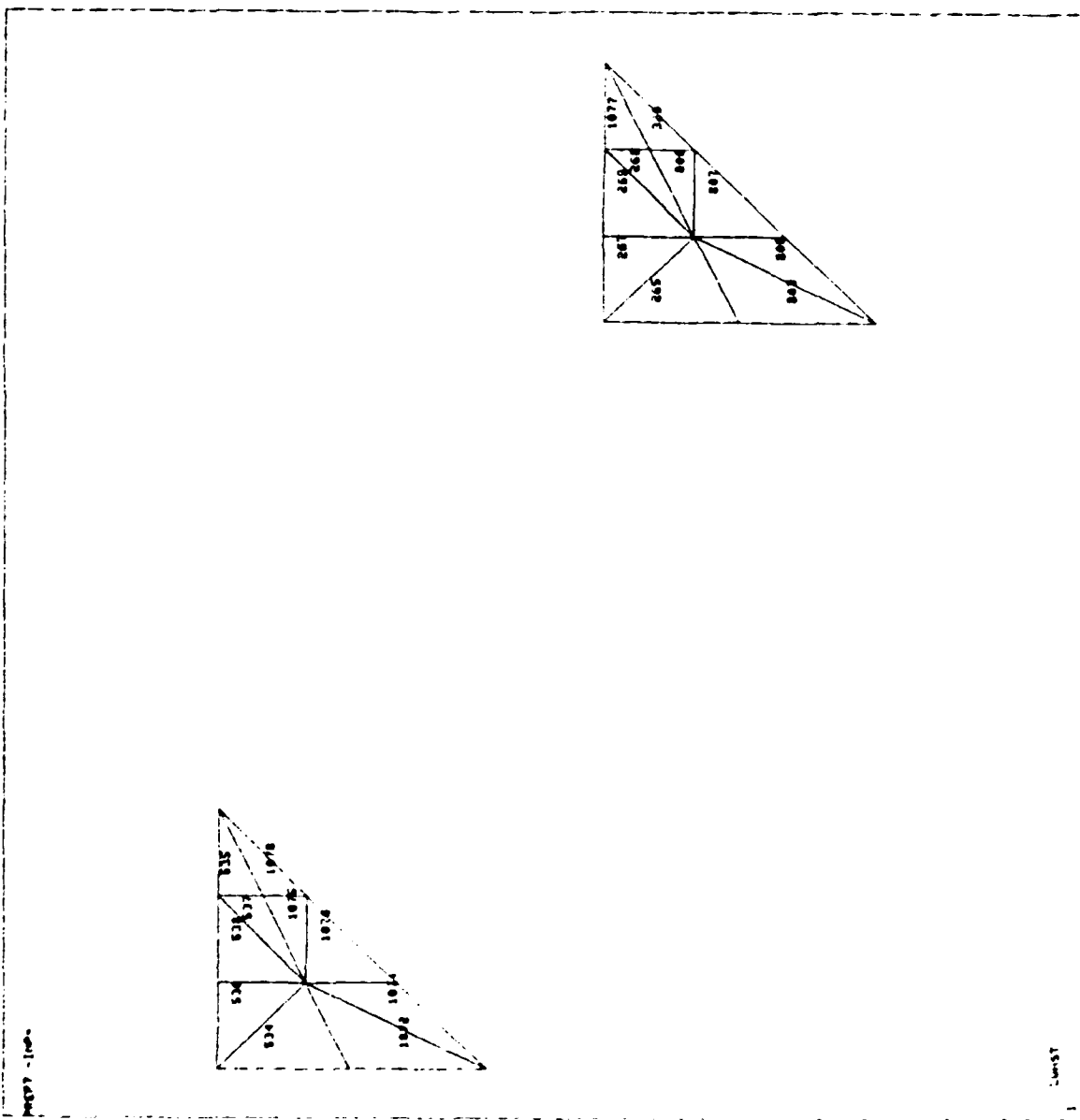
45

Diagram illustrating a complex geometric structure, likely a crystal or a mechanical component, showing a network of lines and points. The structure is elongated and features a central vertical axis. Key points and lines are labeled with numbers:

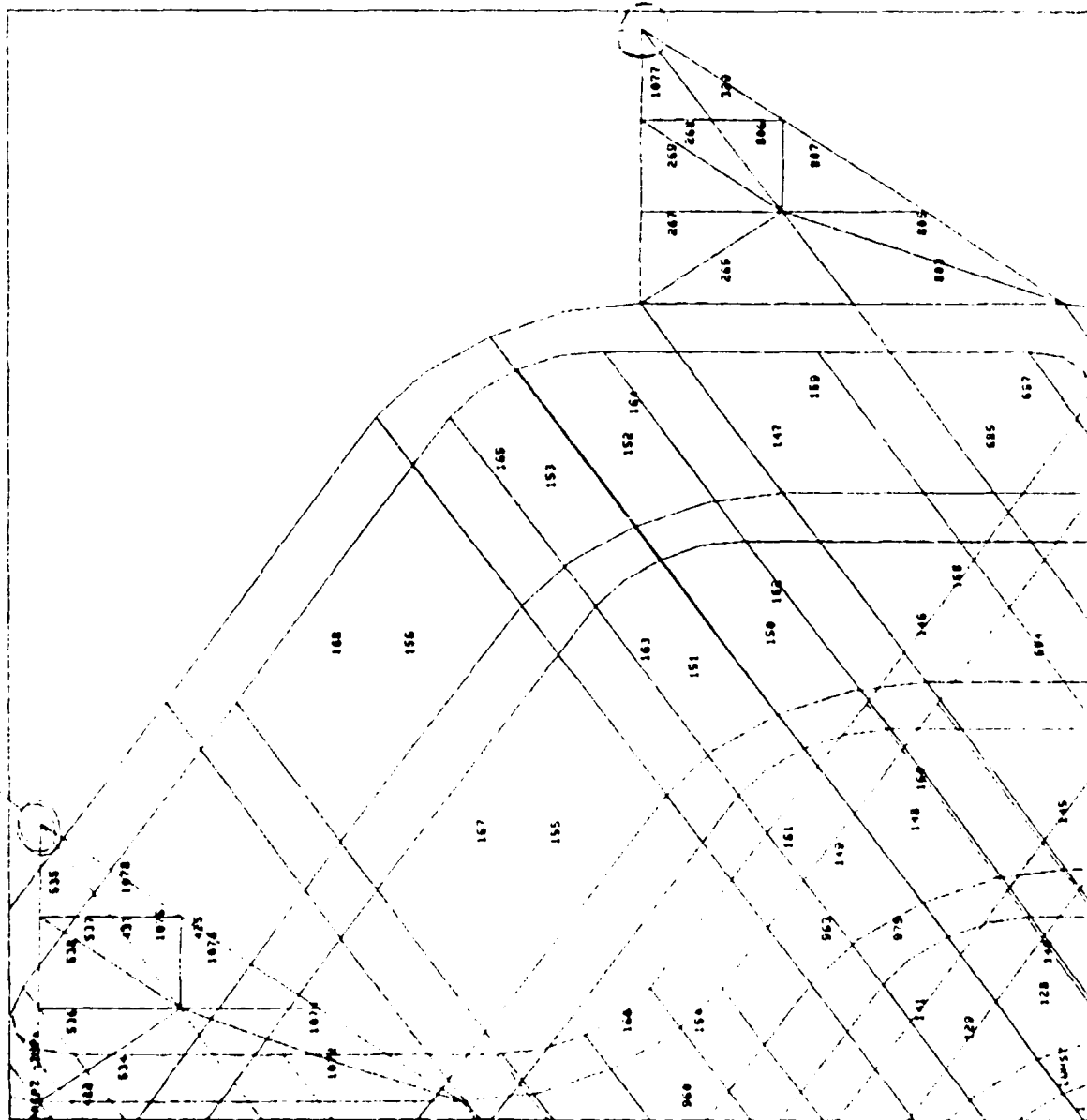
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1005

ANSYS 4.28
 NOV 13 1986
 16155144
 PREP7 ELEMENTS
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 KU=1
 VU=1
 ZU=1
 DIS1=73.8
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 MTO=4.23
 VMT0=3.84

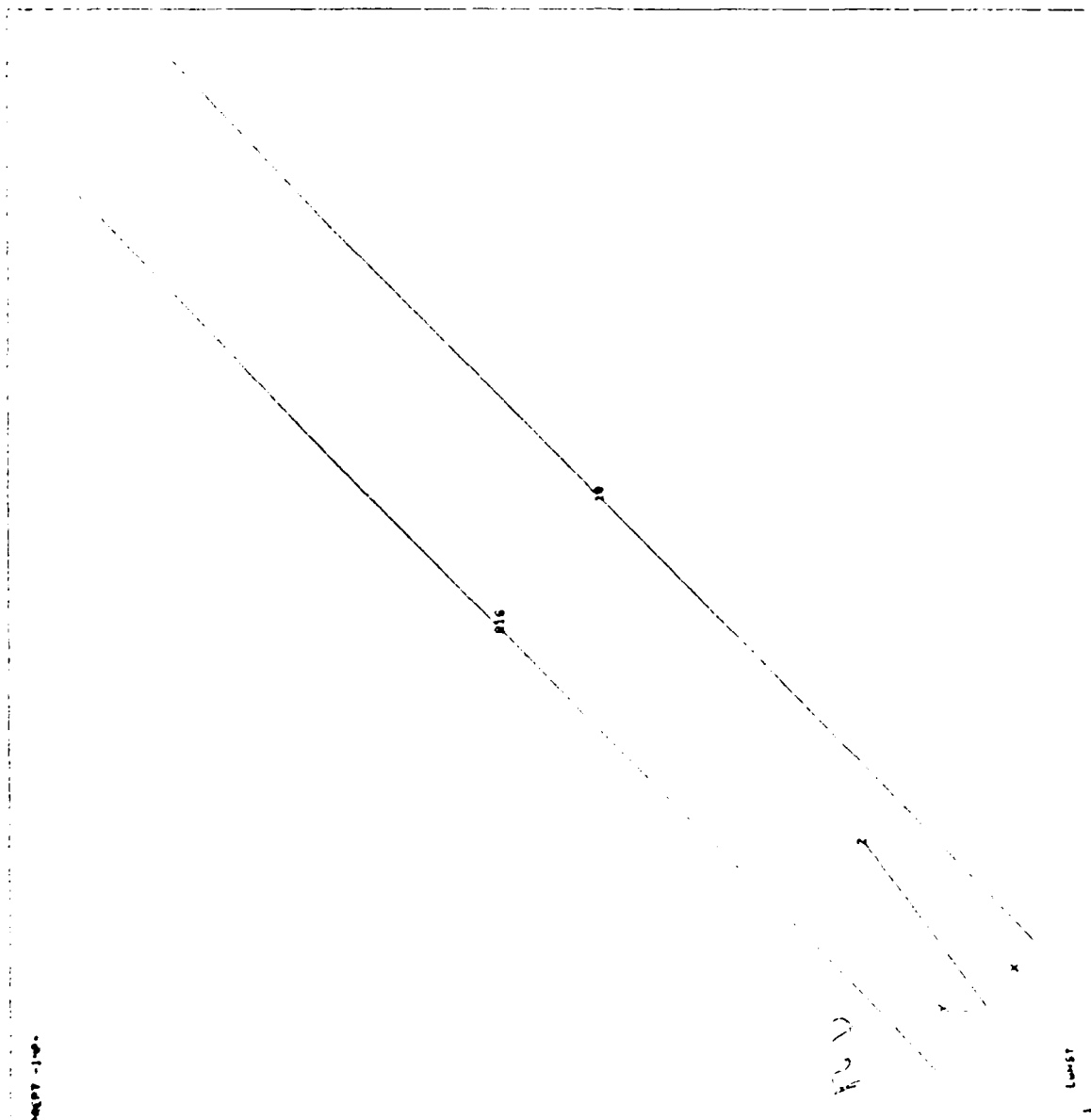


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 VF=1.85
 Z=1.236
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 WATC=5.66



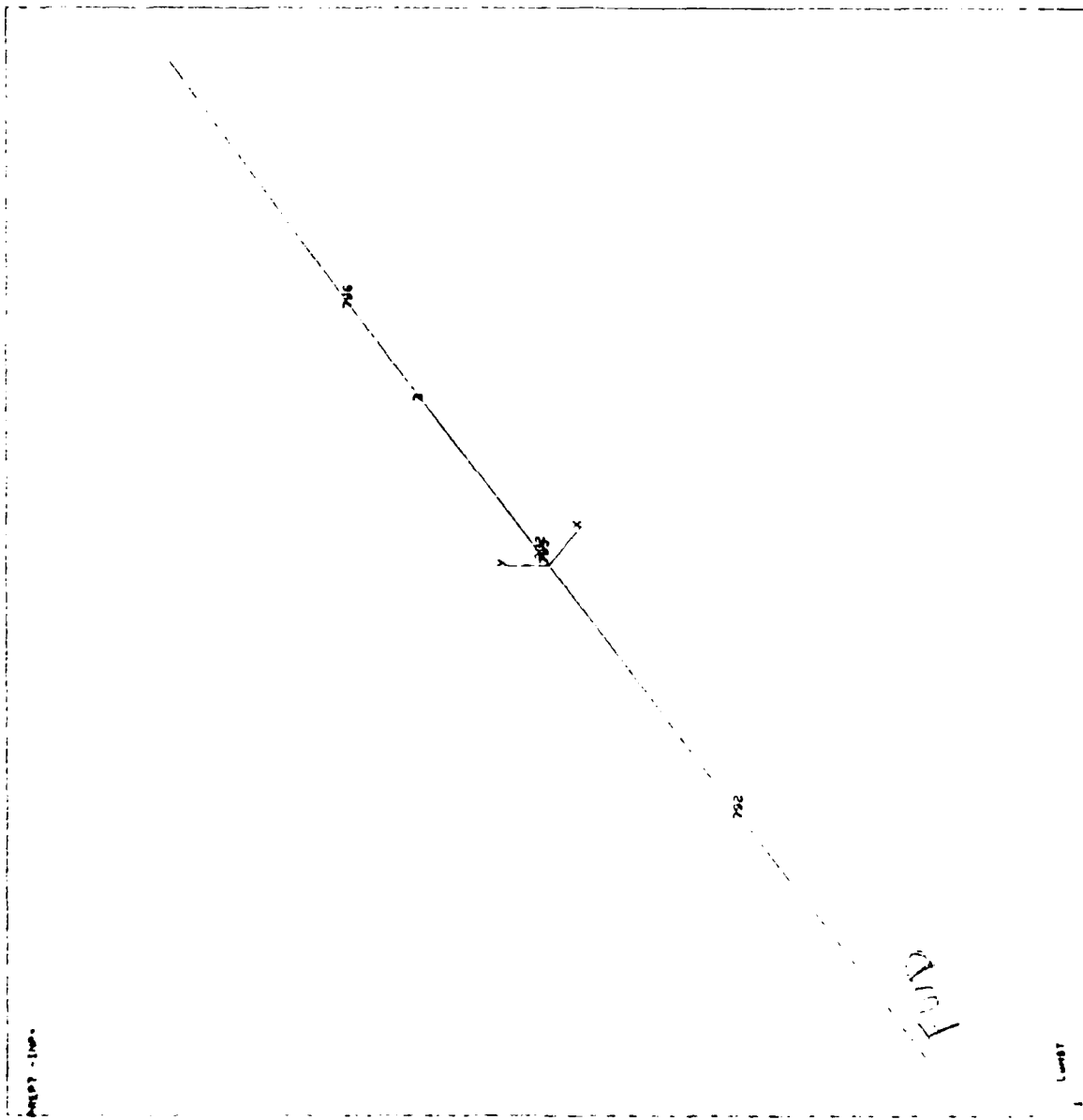
CABLES

ANALYSIS 4.28
NOV 13 1966
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YU=1
ZU=1
DIST=489
VF=17.5
ZF=122
MTO=4.23
VTO=5.66



ANVS 4.20
NOV 13 1966
16100146
PREPT ELEMENTS
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ZCOR
KX-1
KX-1
KX-1
ZU-1
DIST-344
ZF-5
ARTD-4.23
VATO-5.66

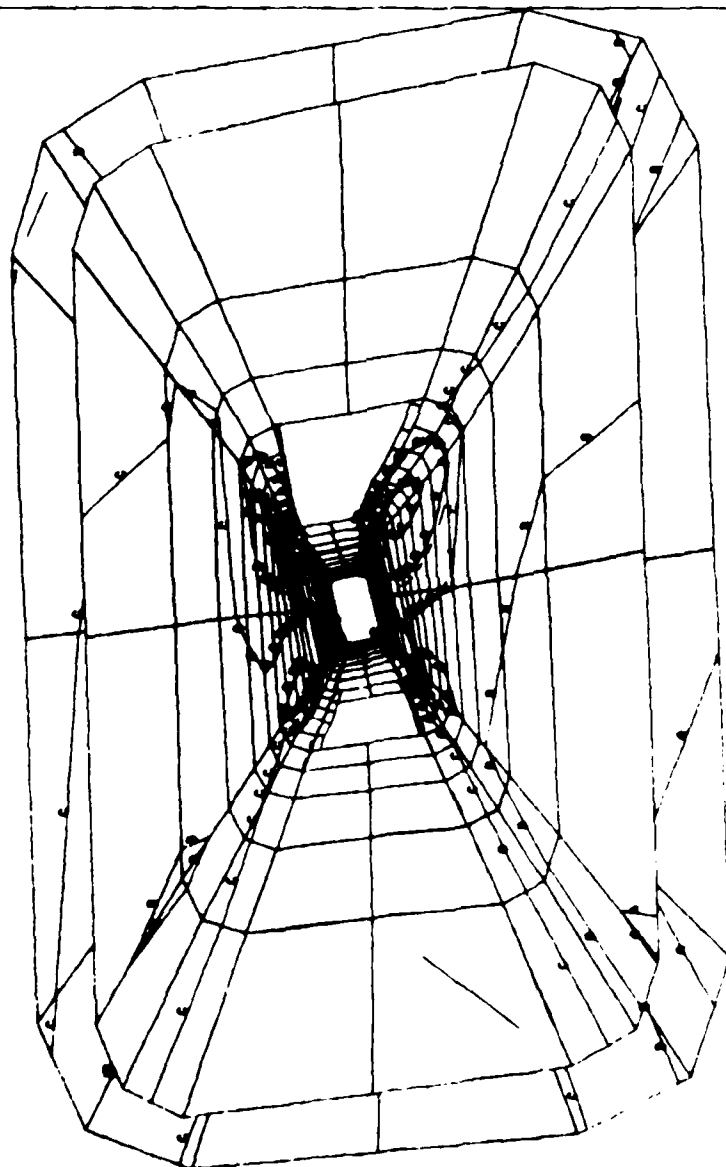
GUN



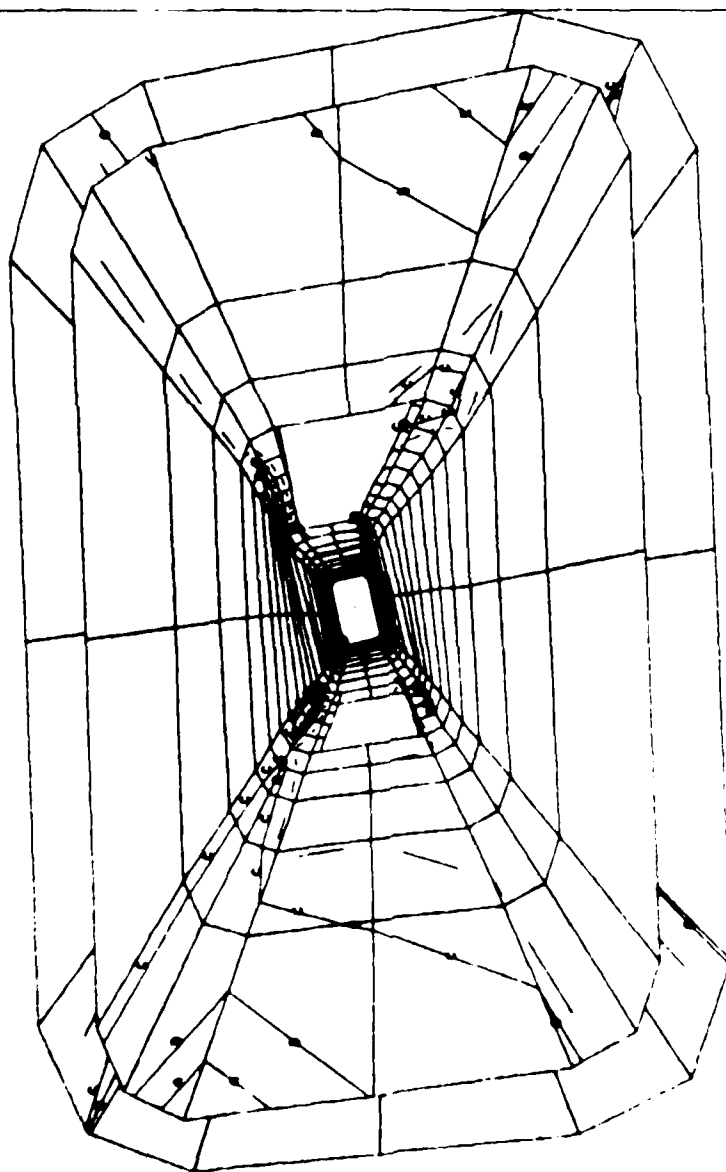
D2/351

CRADLE MODEL

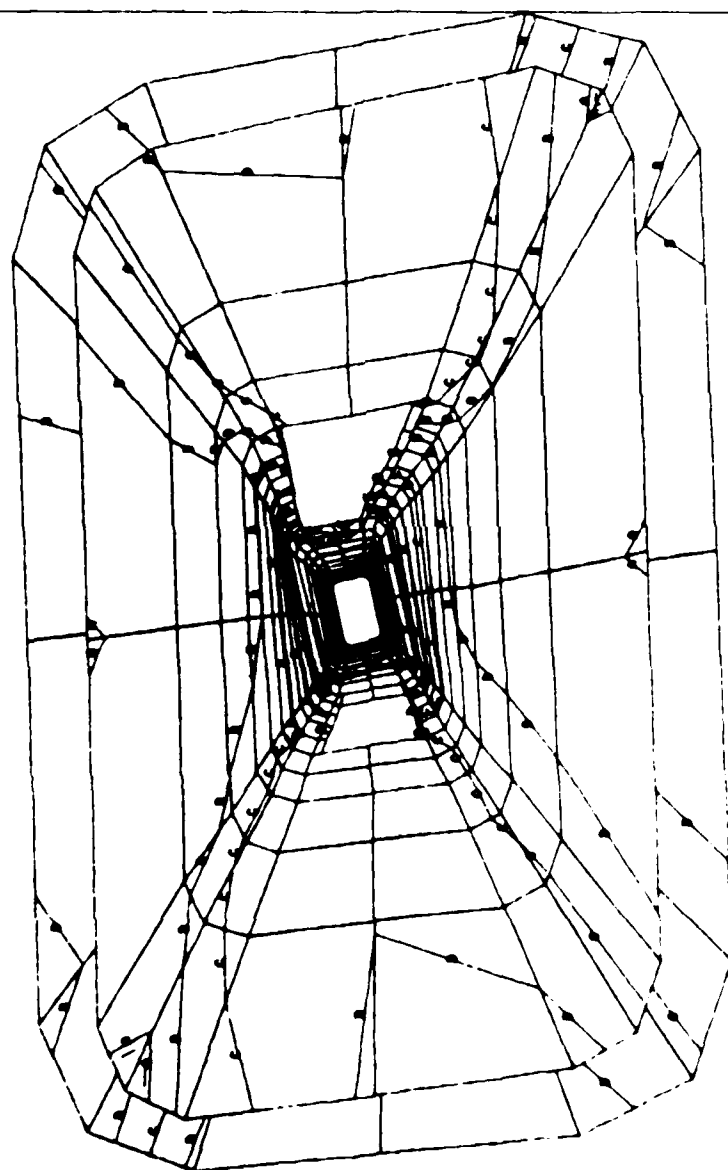
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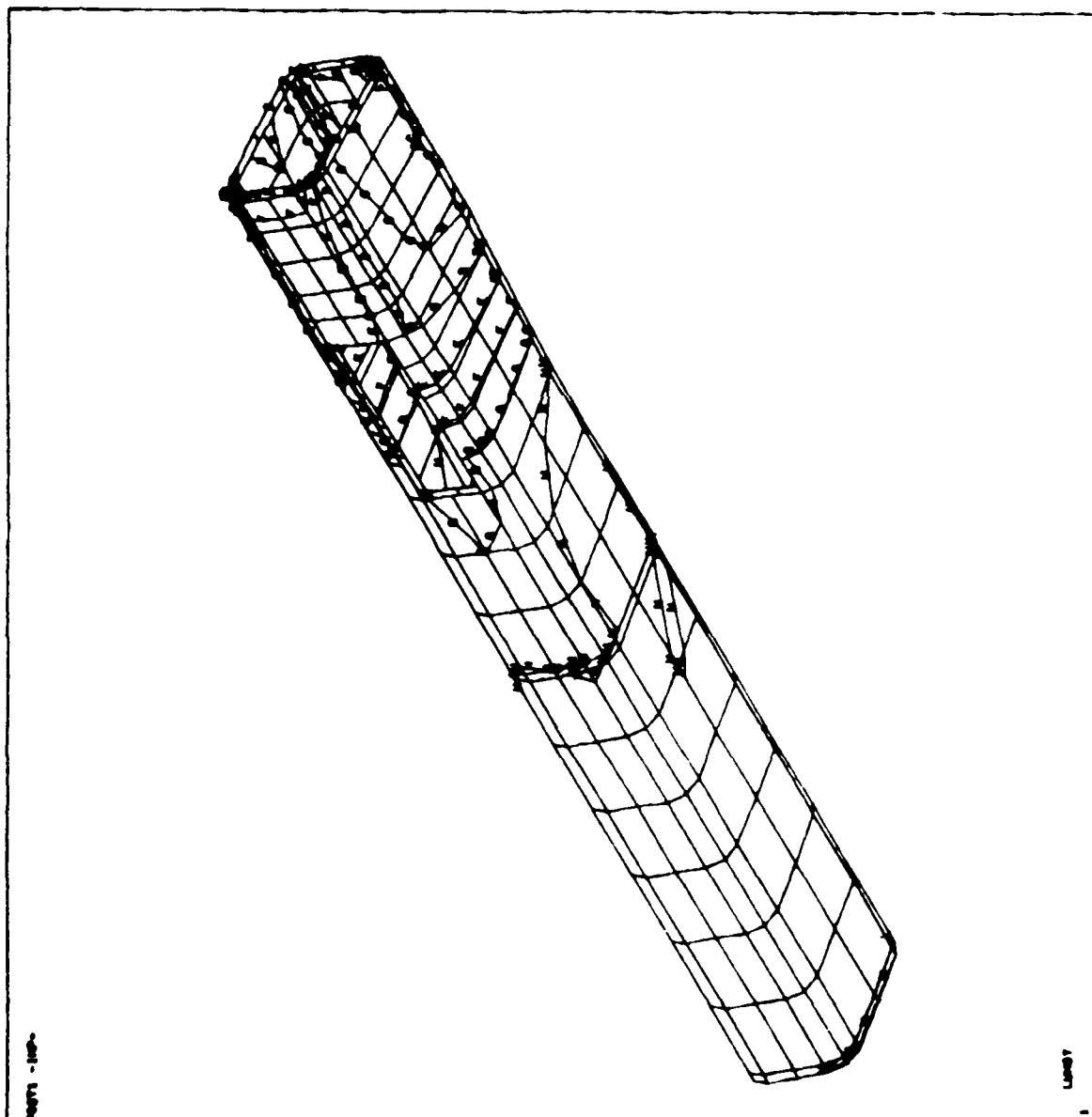


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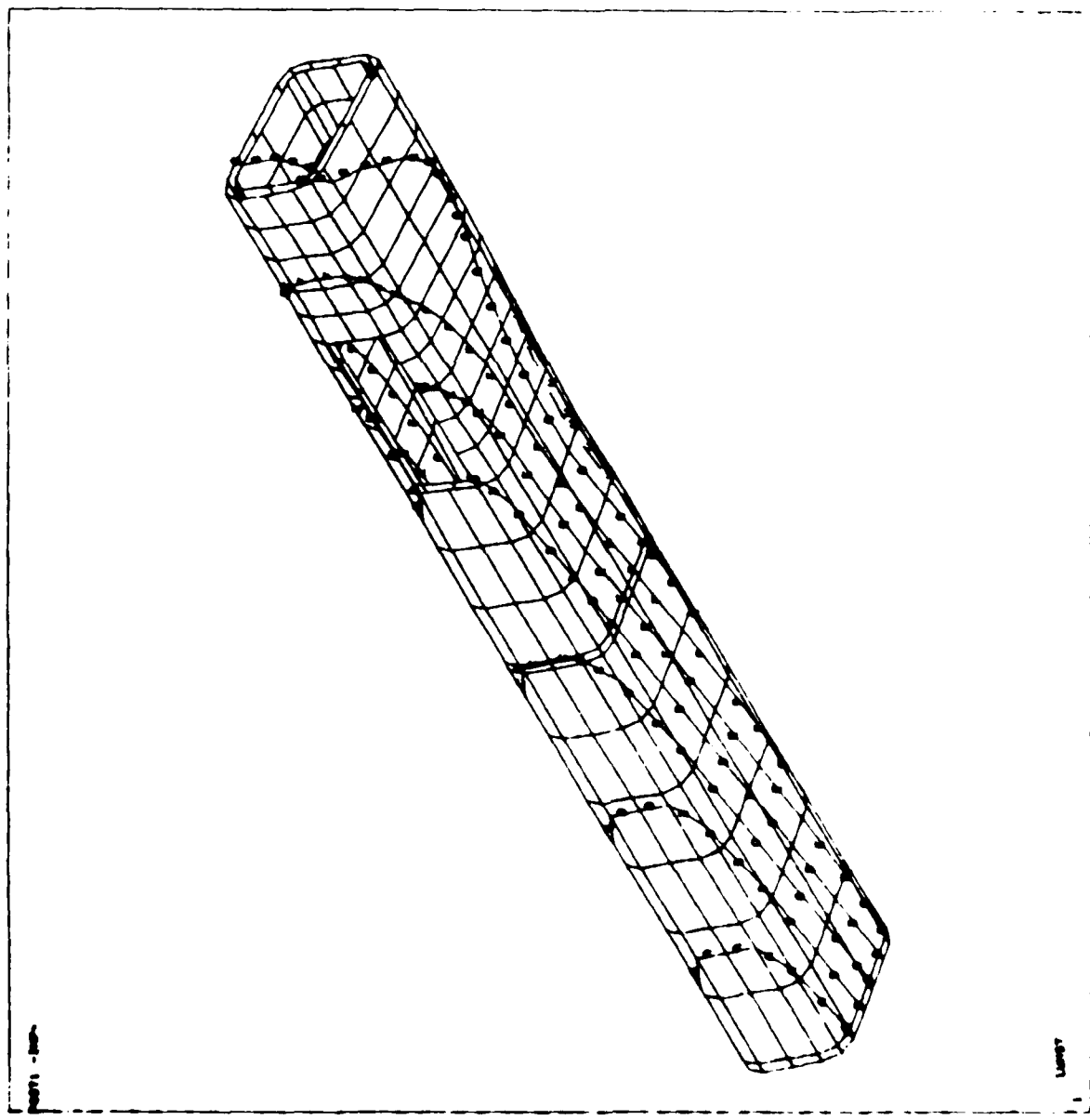
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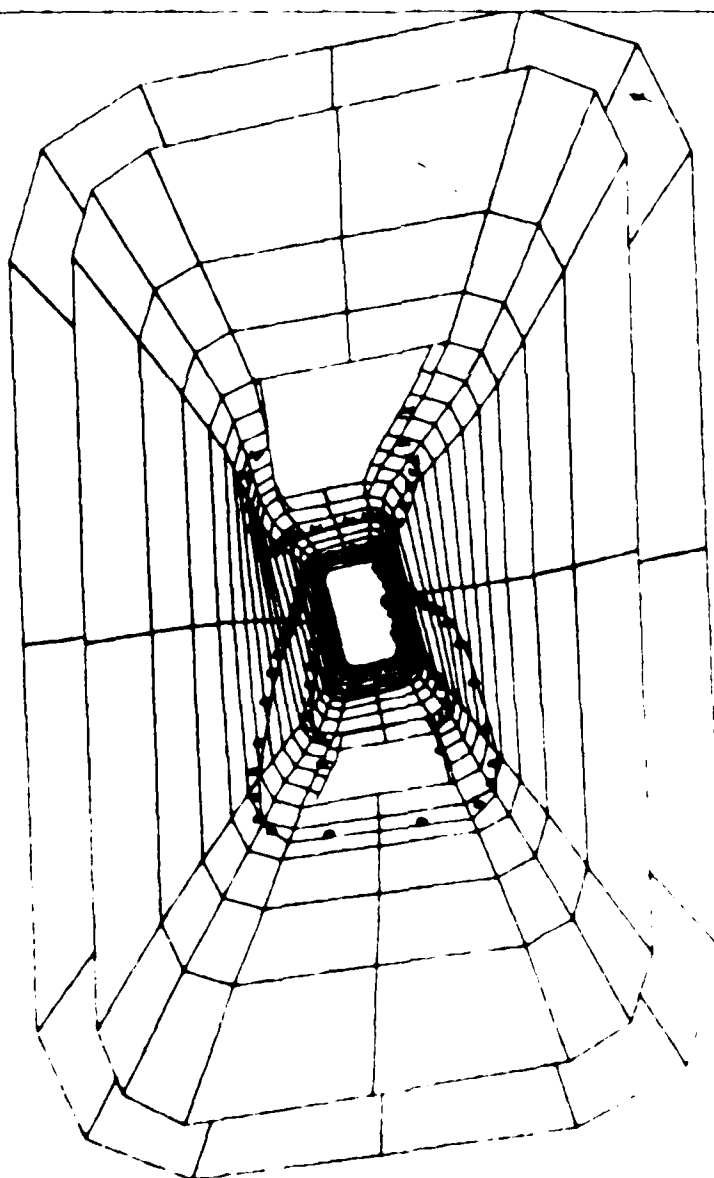

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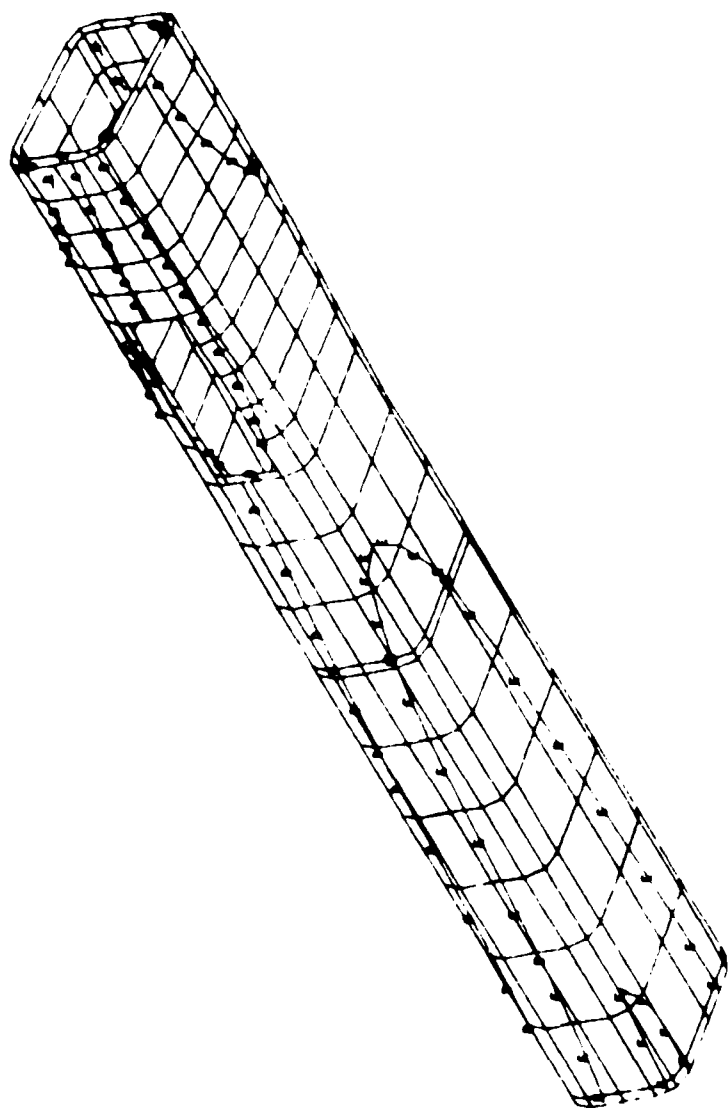
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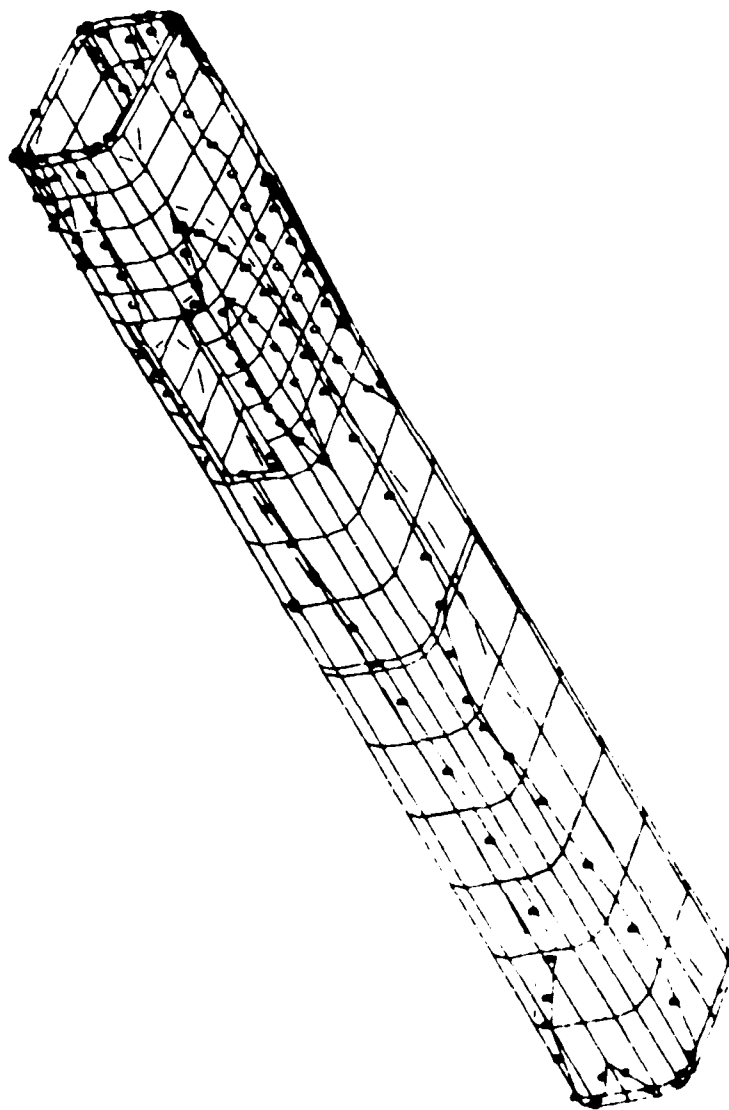
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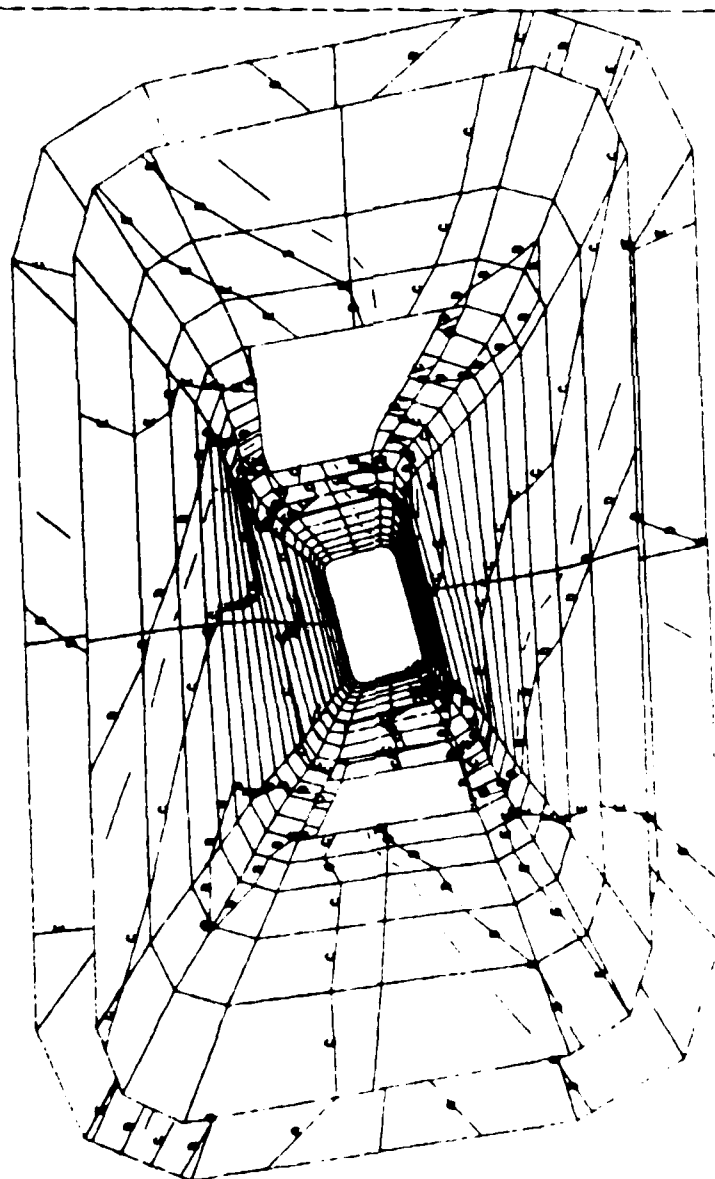
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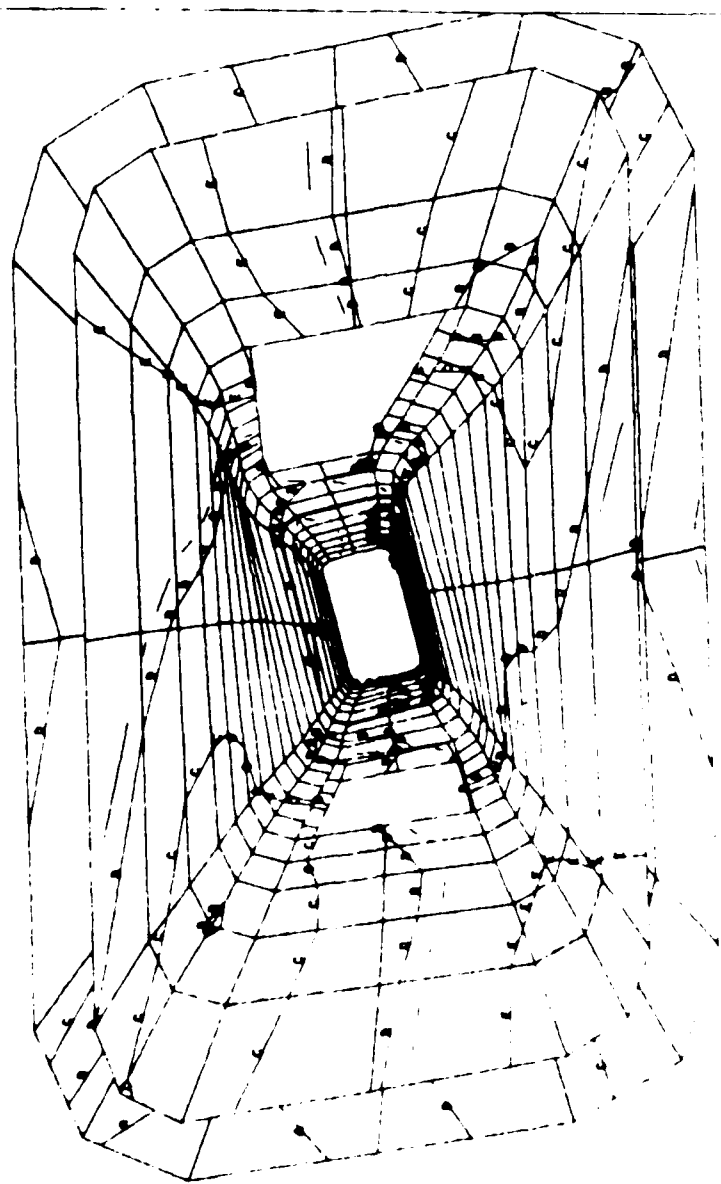
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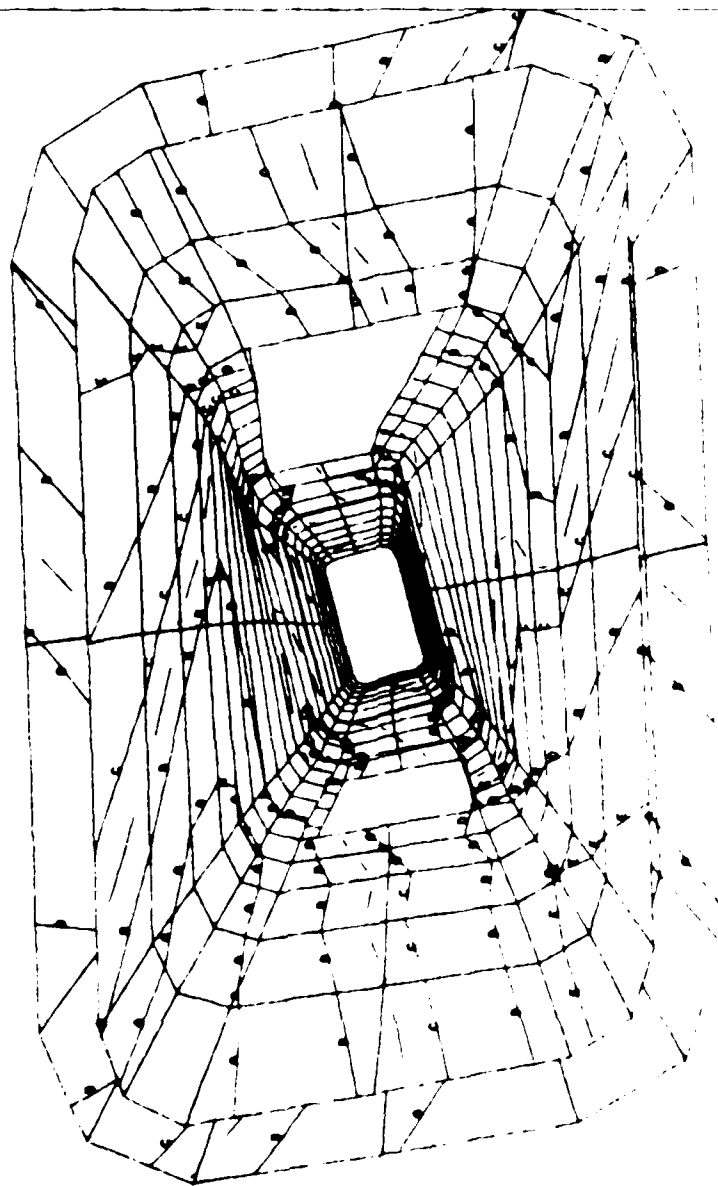
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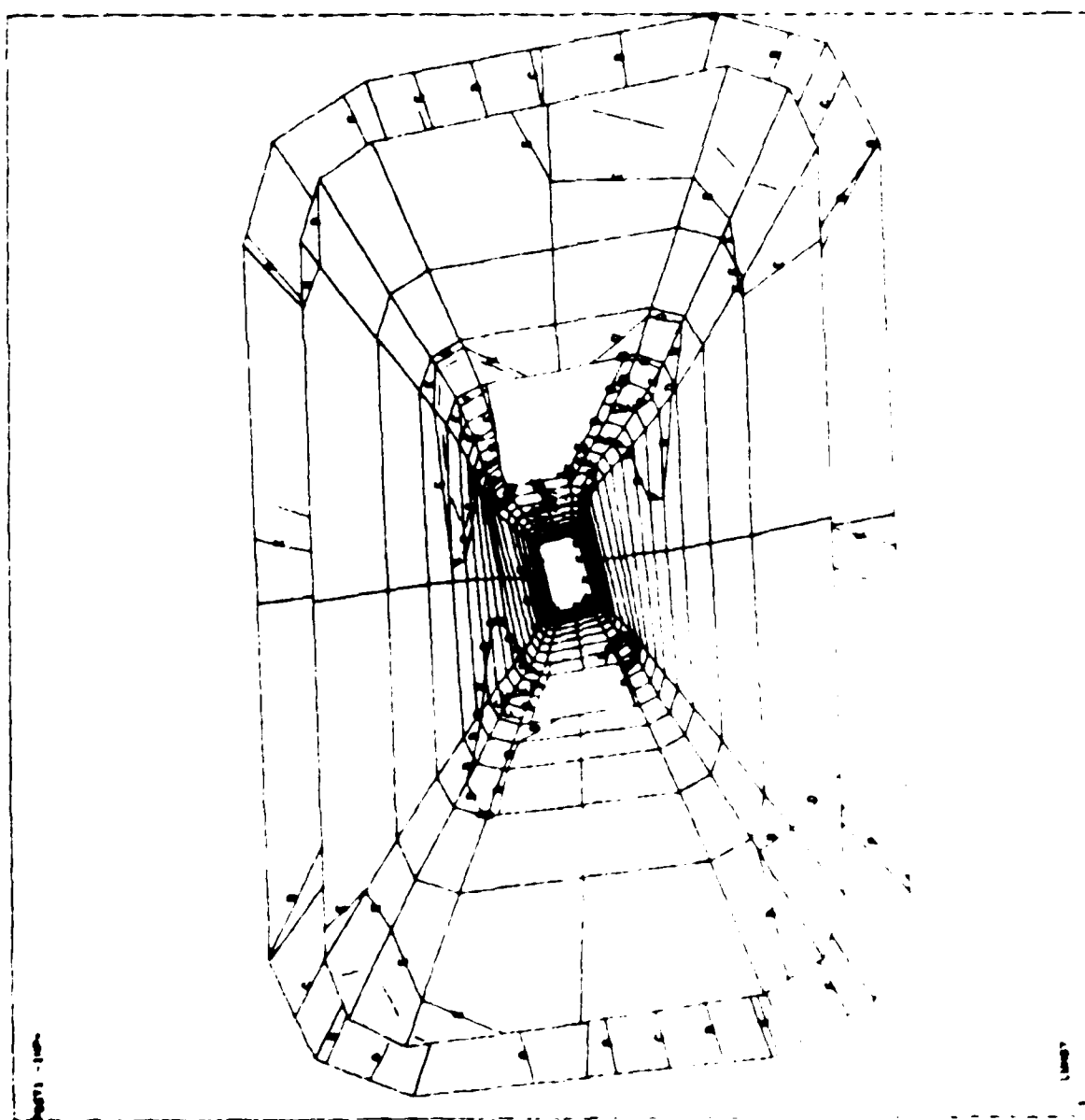
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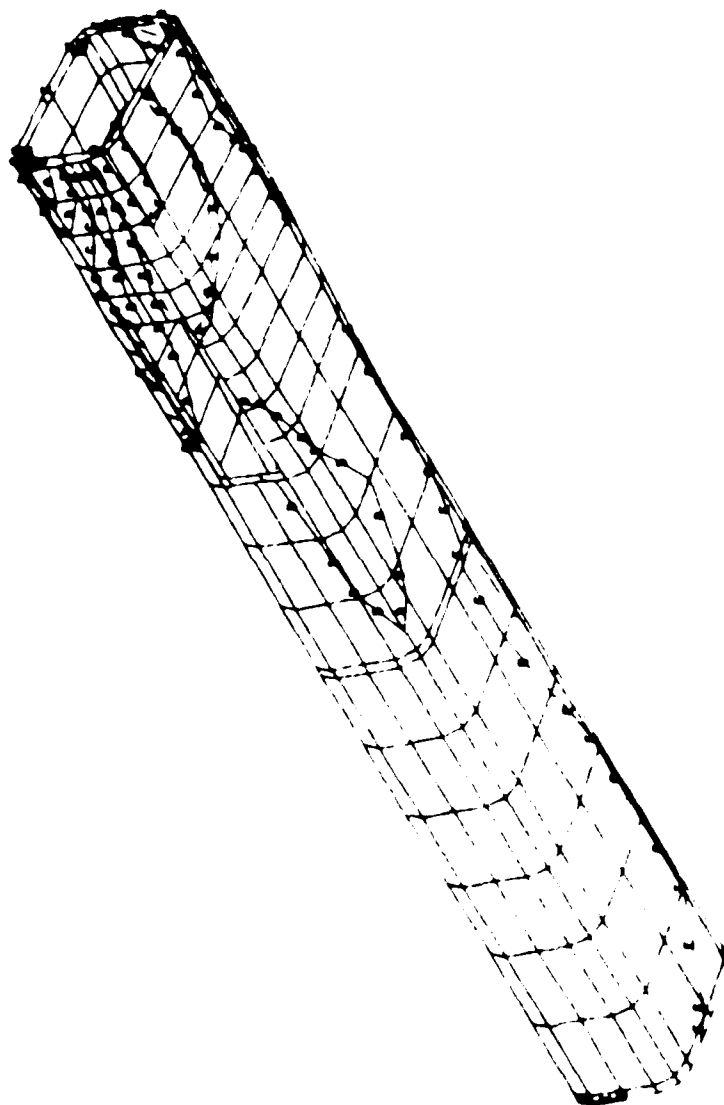


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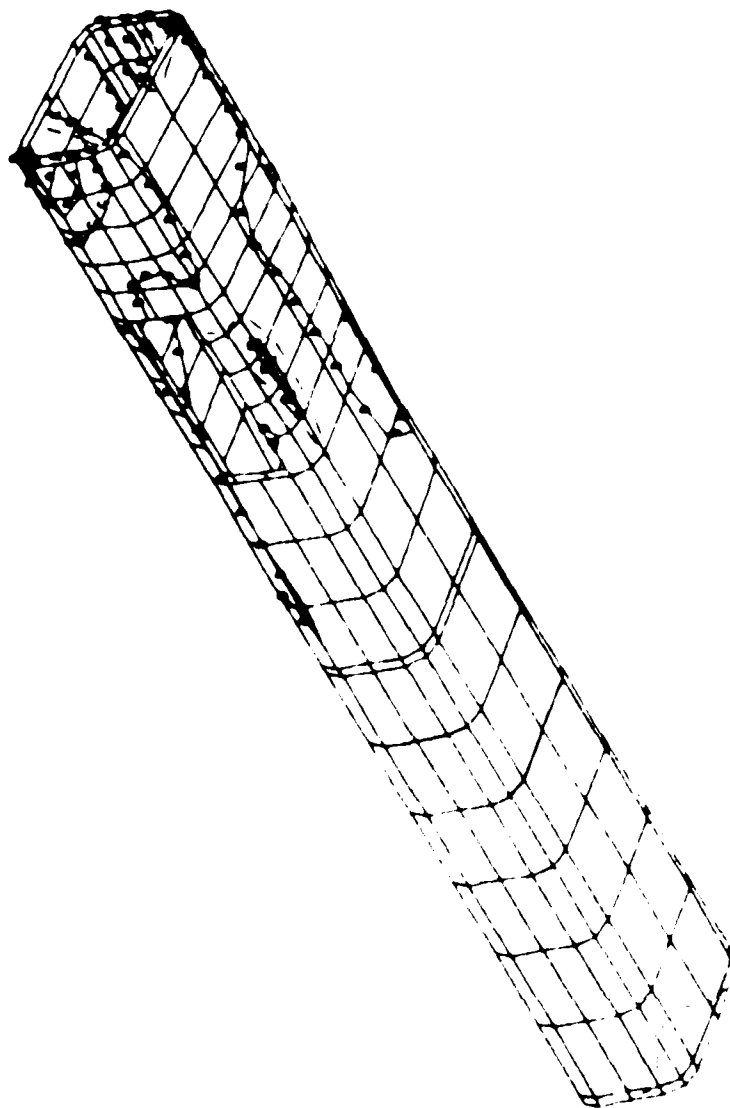


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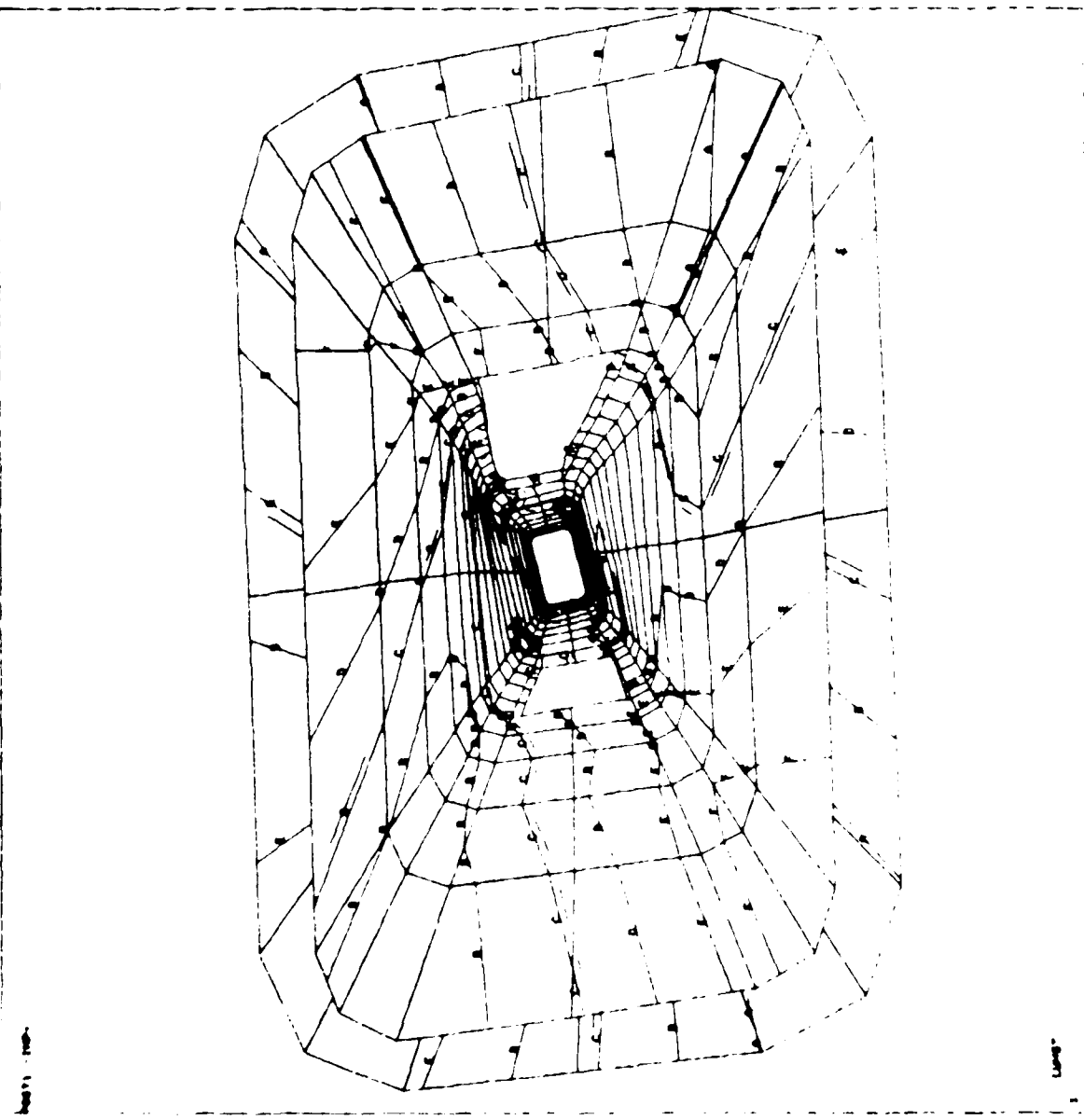
A complex geometric diagram showing a perspective view of a rectangular structure. The structure is composed of a grid of lines and points, forming a series of nested rectangles that converge towards a central point. The lines are drawn with varying thicknesses, and the points are marked with small black dots. The overall shape is a rectangular prism, viewed from an angle that creates a sense of depth. The diagram is a high-contrast black and white image, typical of a photocopy or a technical drawing.

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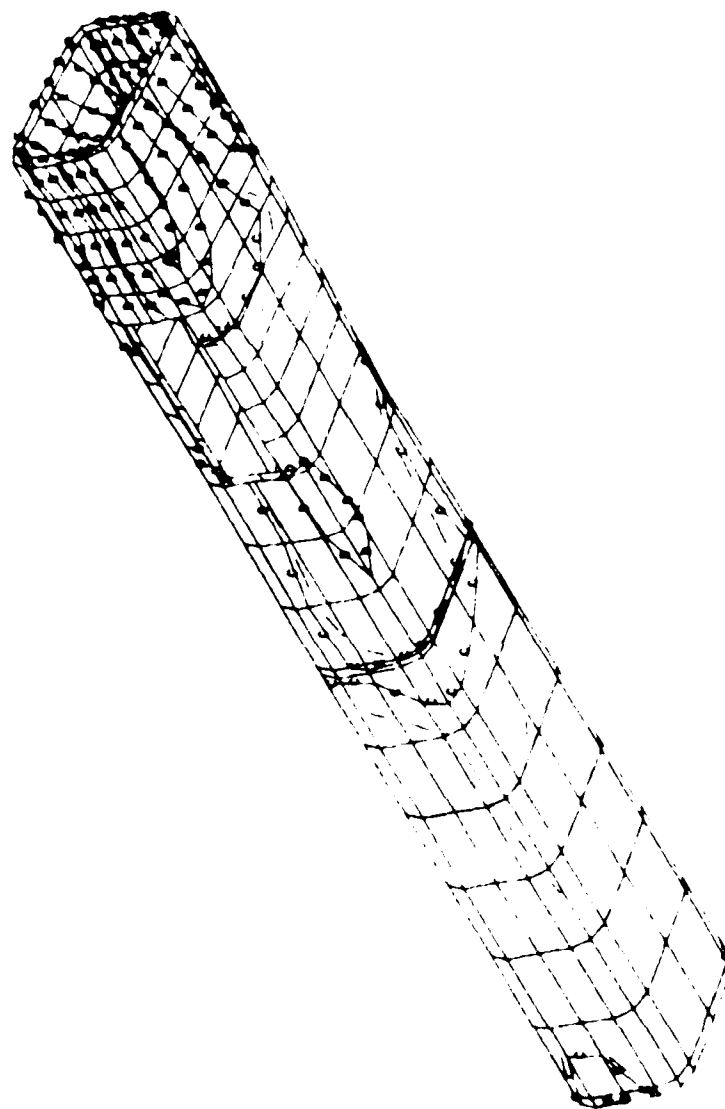
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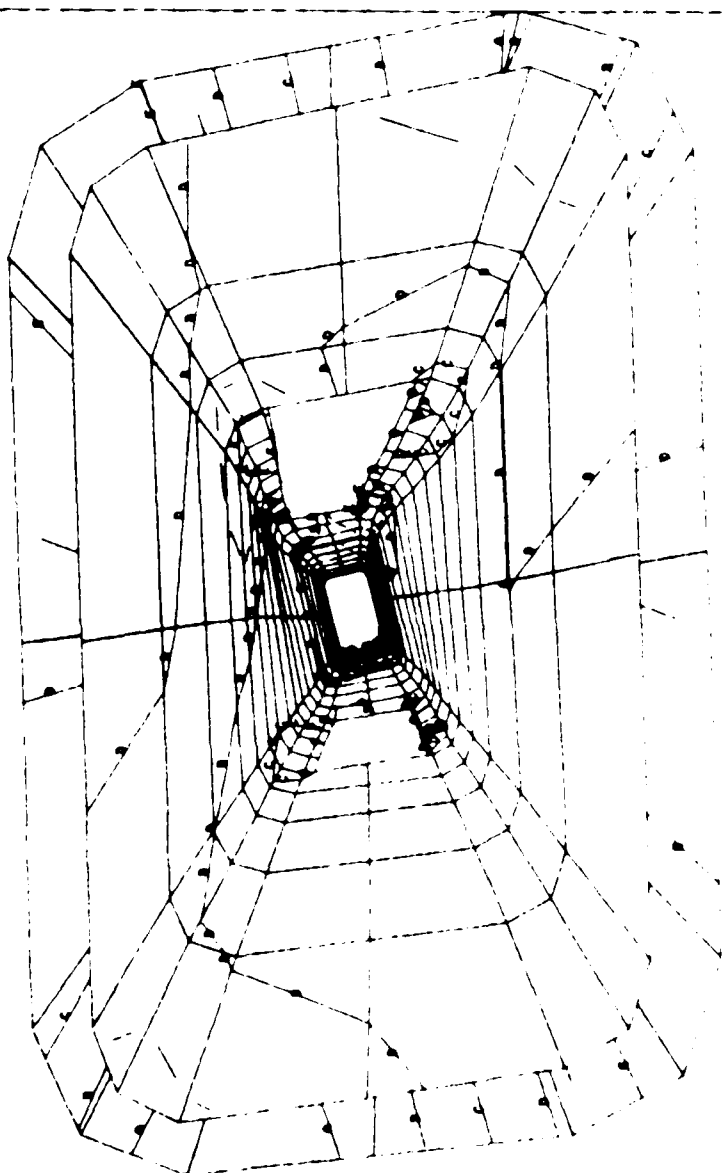
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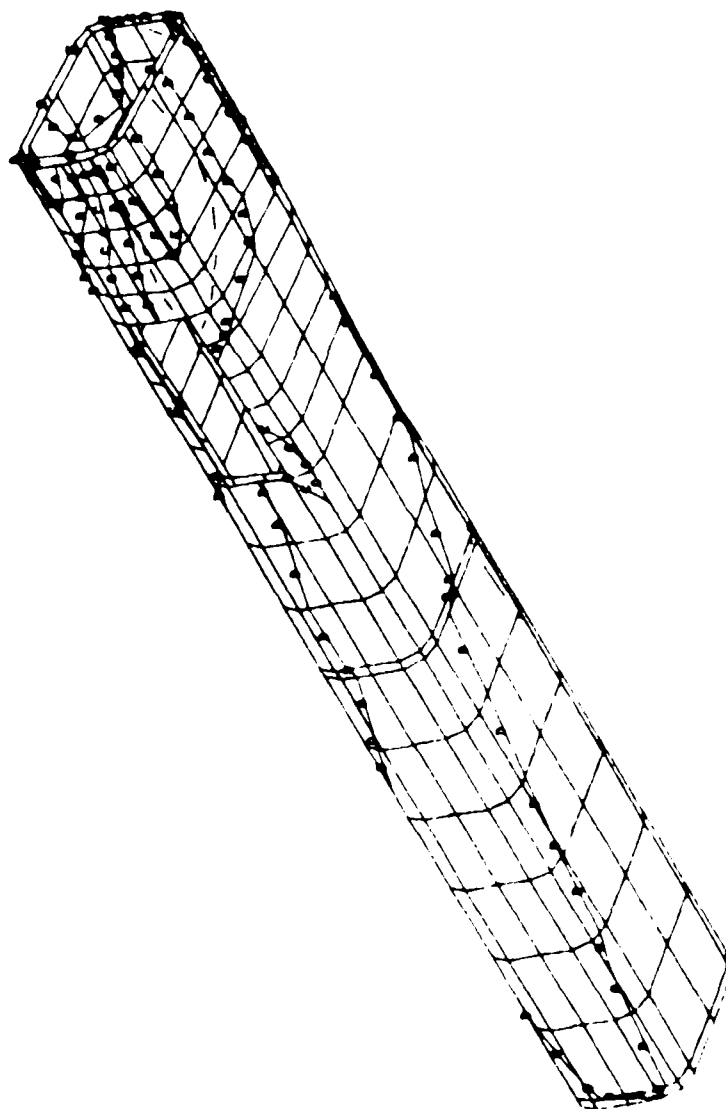
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2011-12



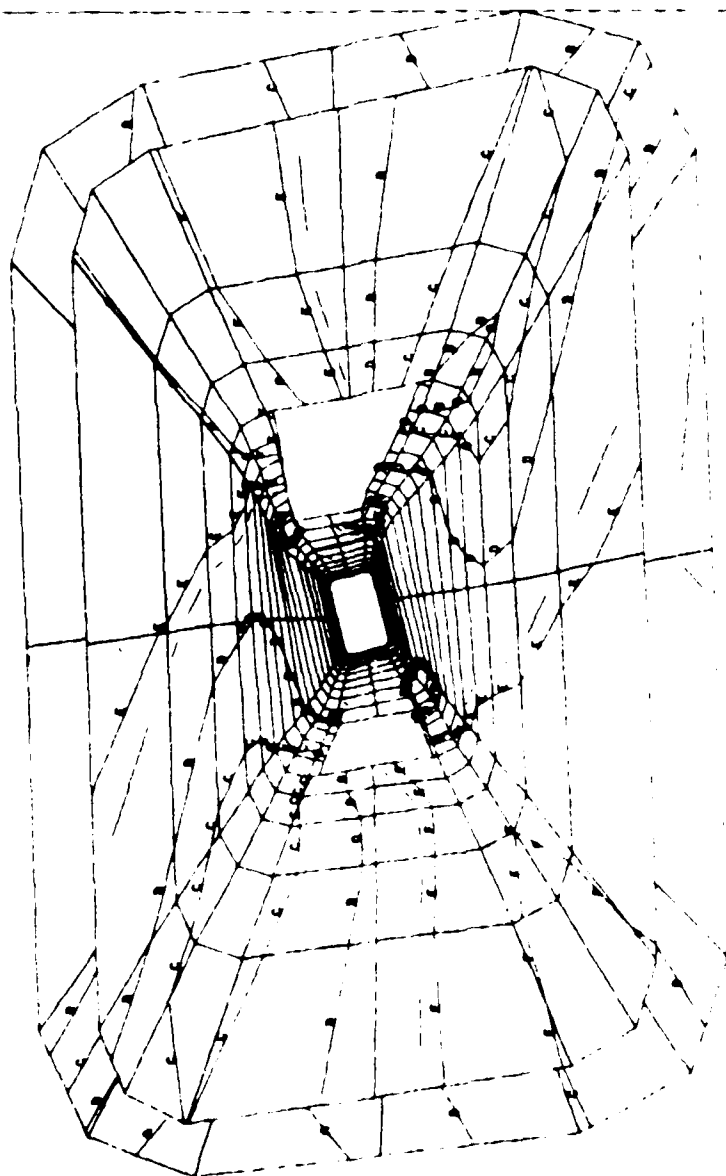
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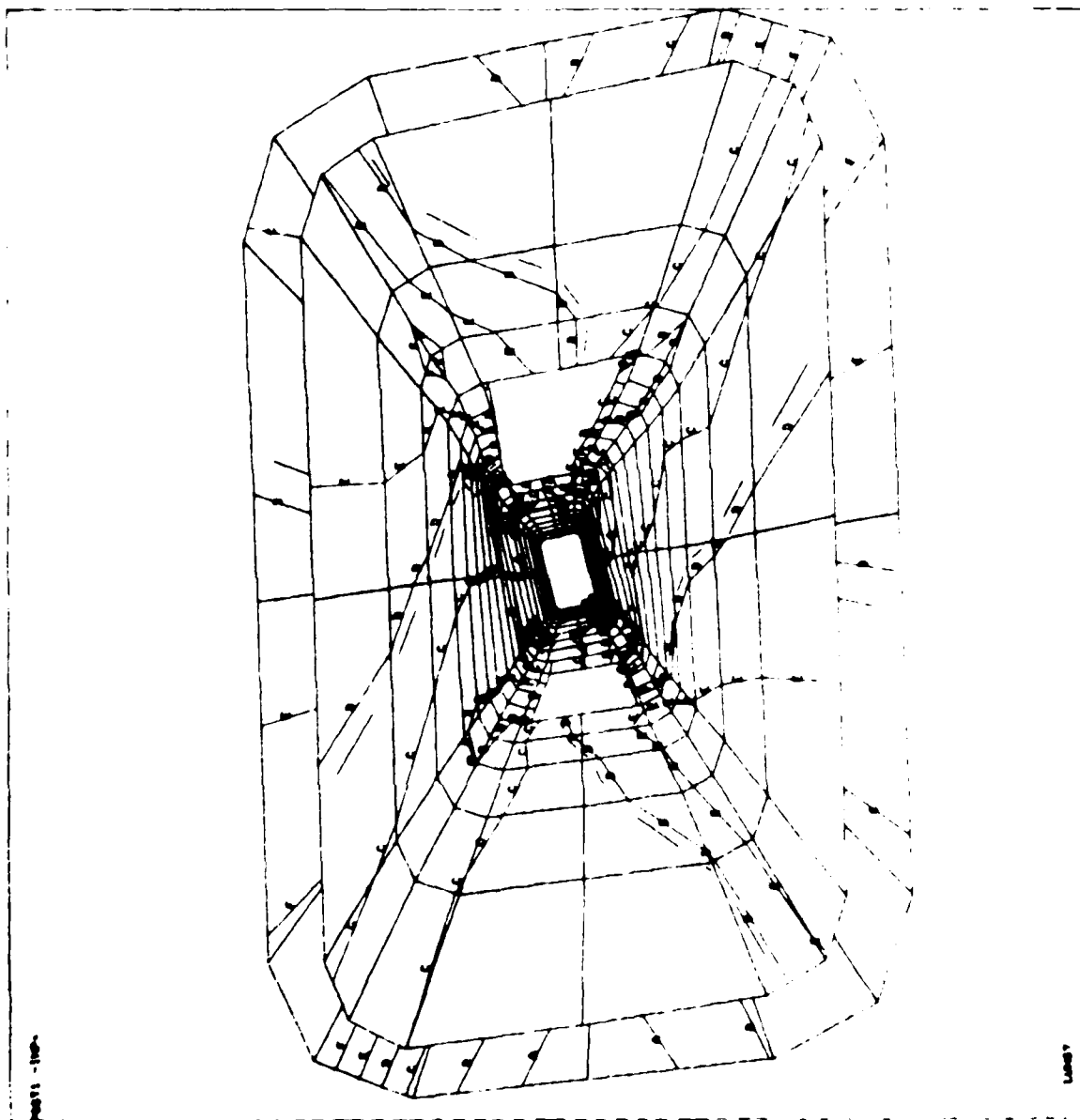


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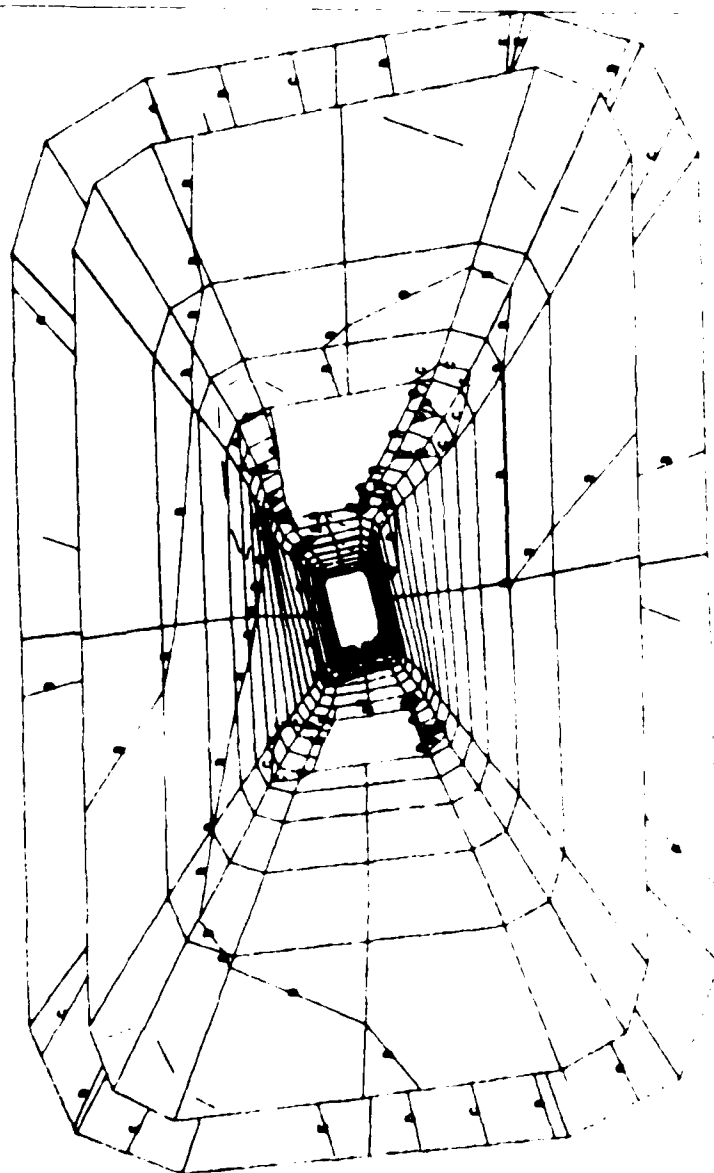
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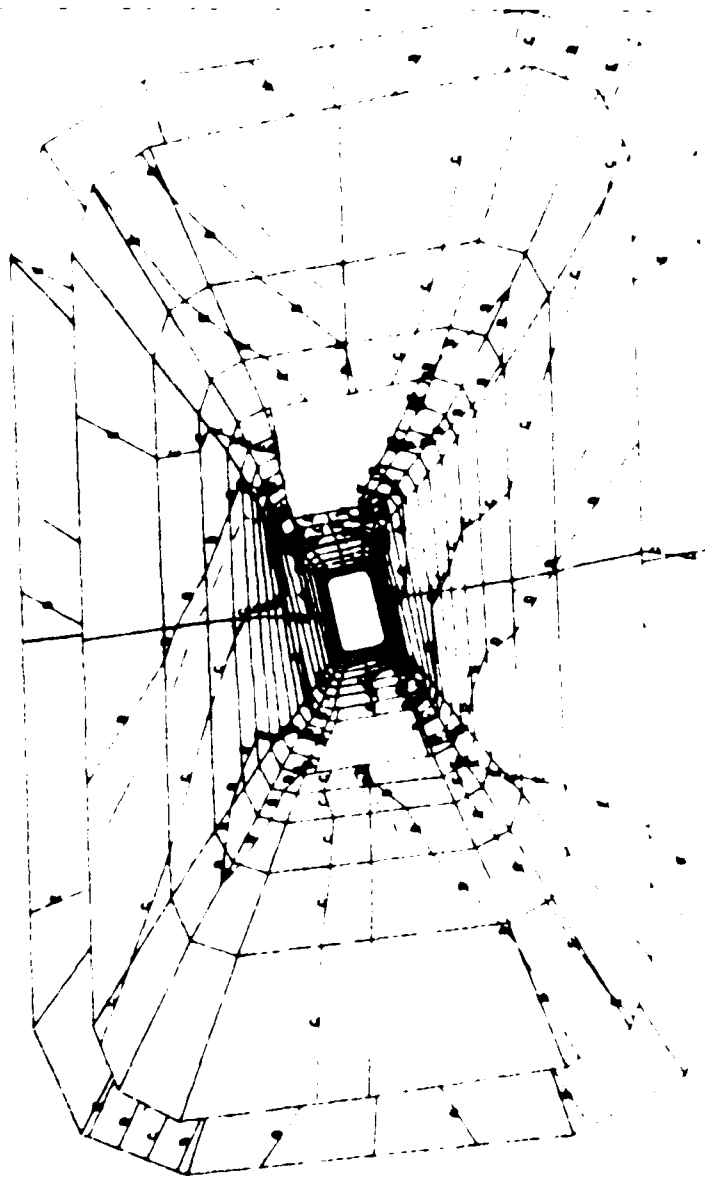
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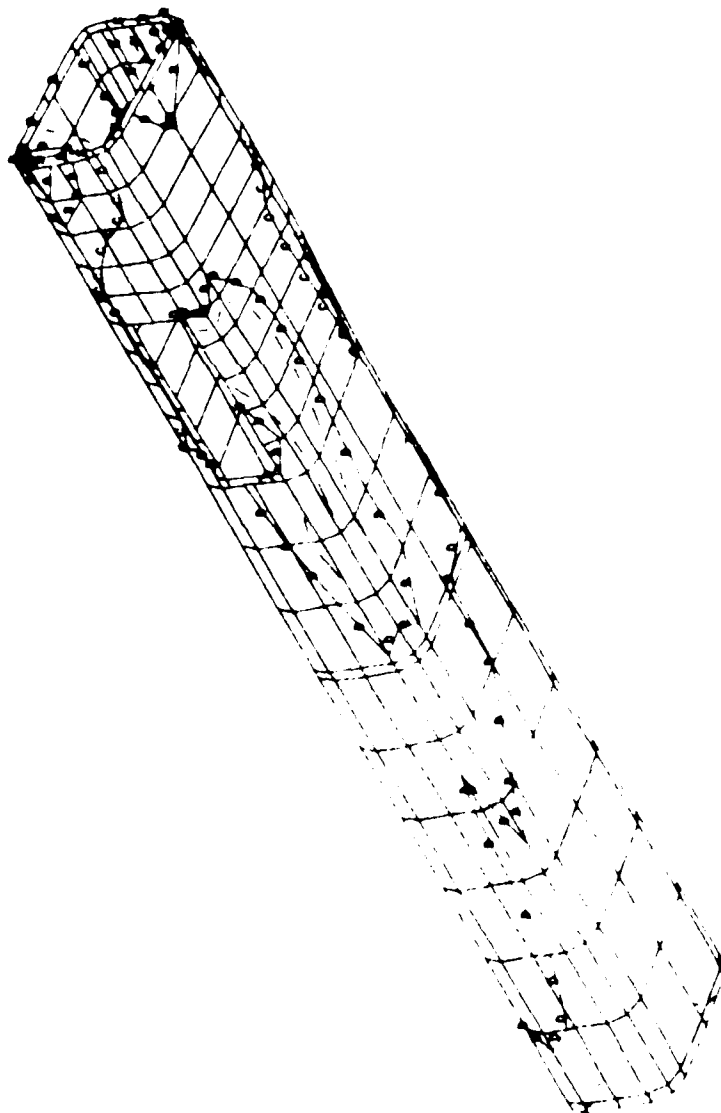
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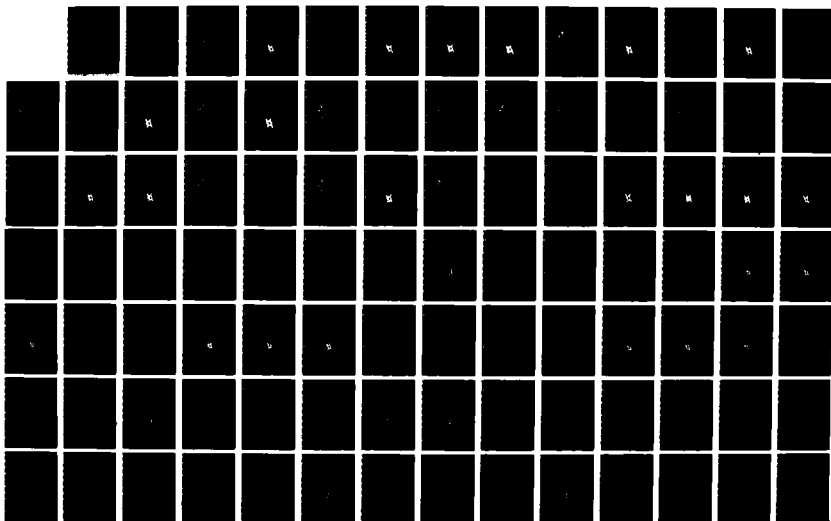
LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND
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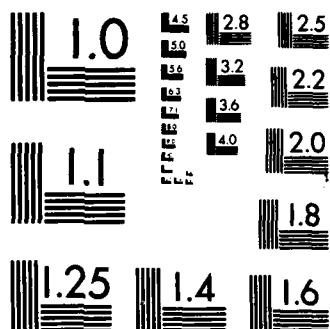
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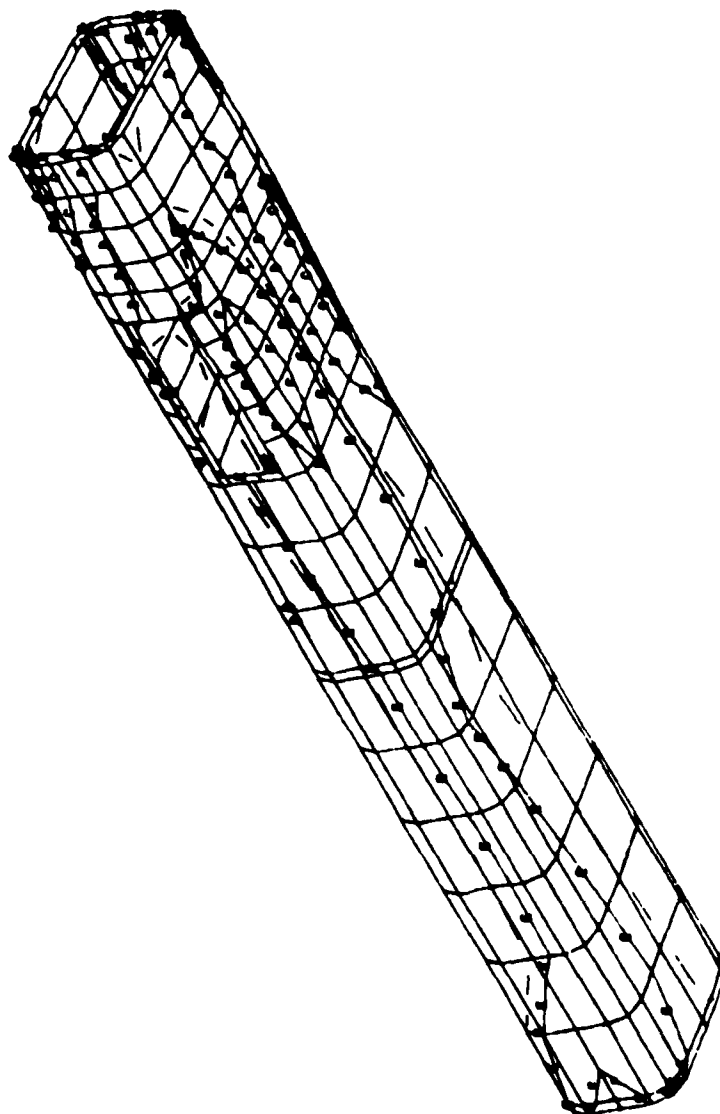
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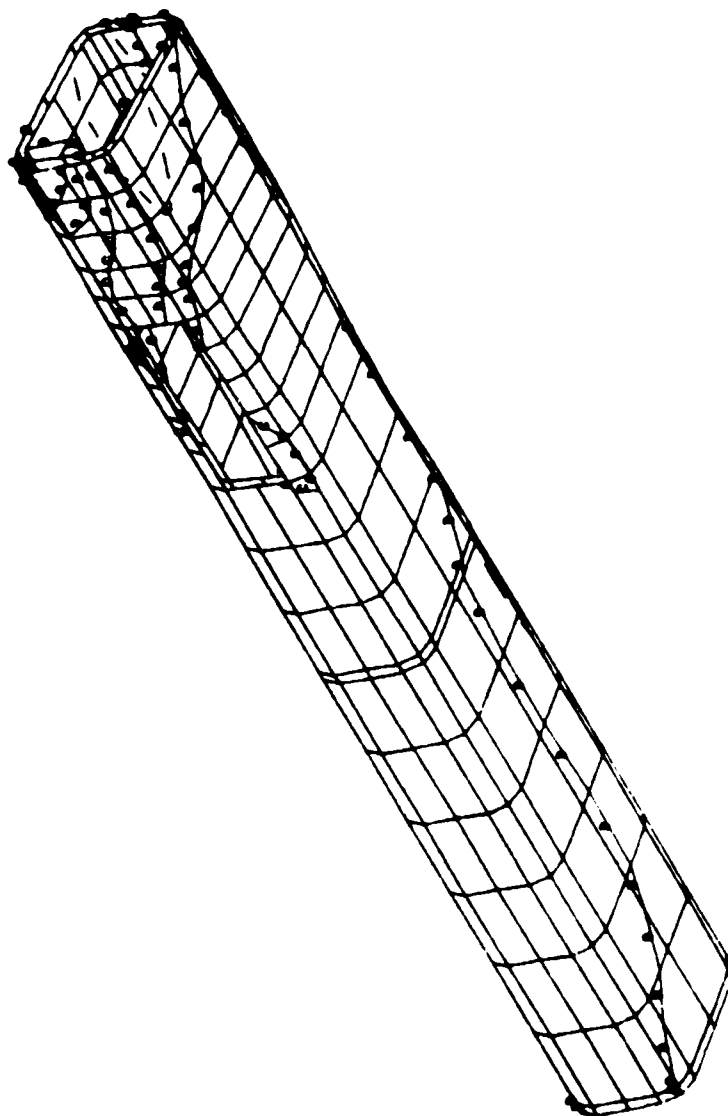
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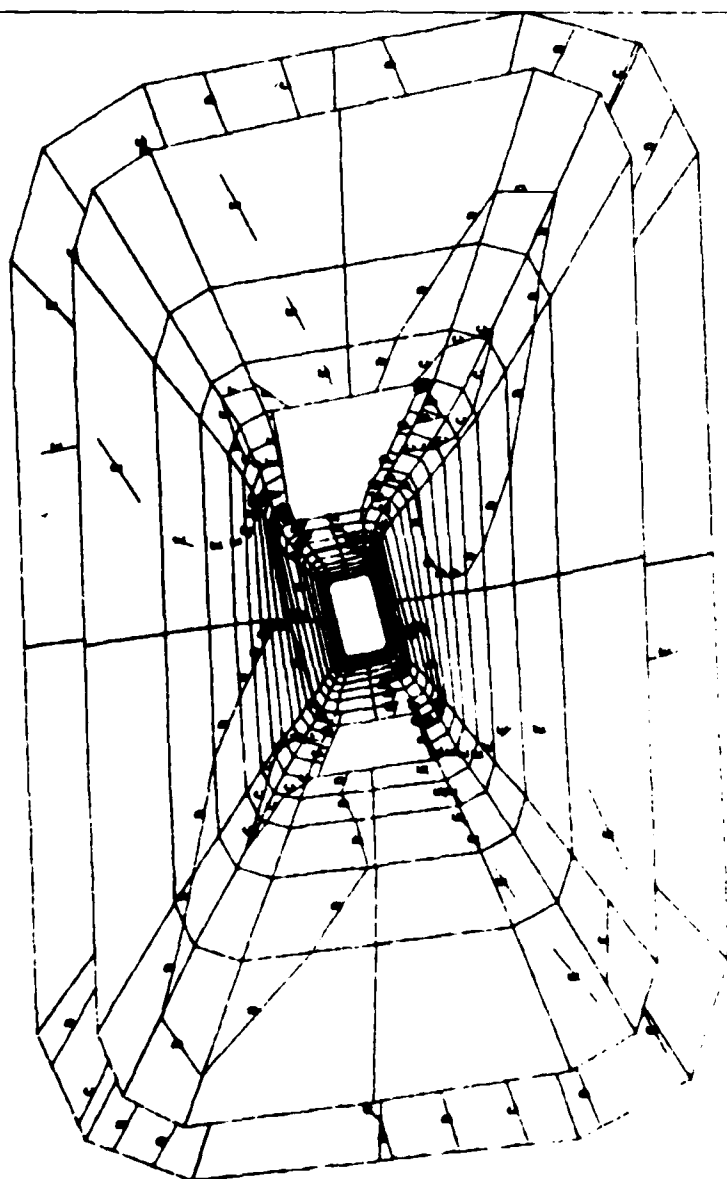
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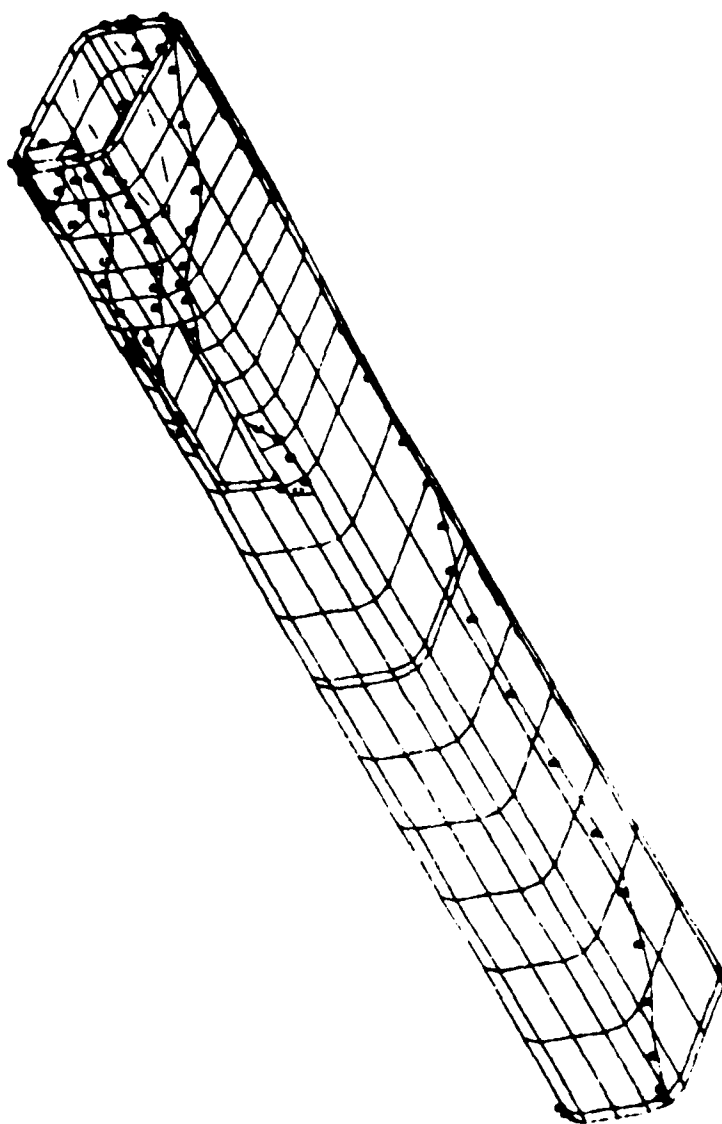
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Page 6



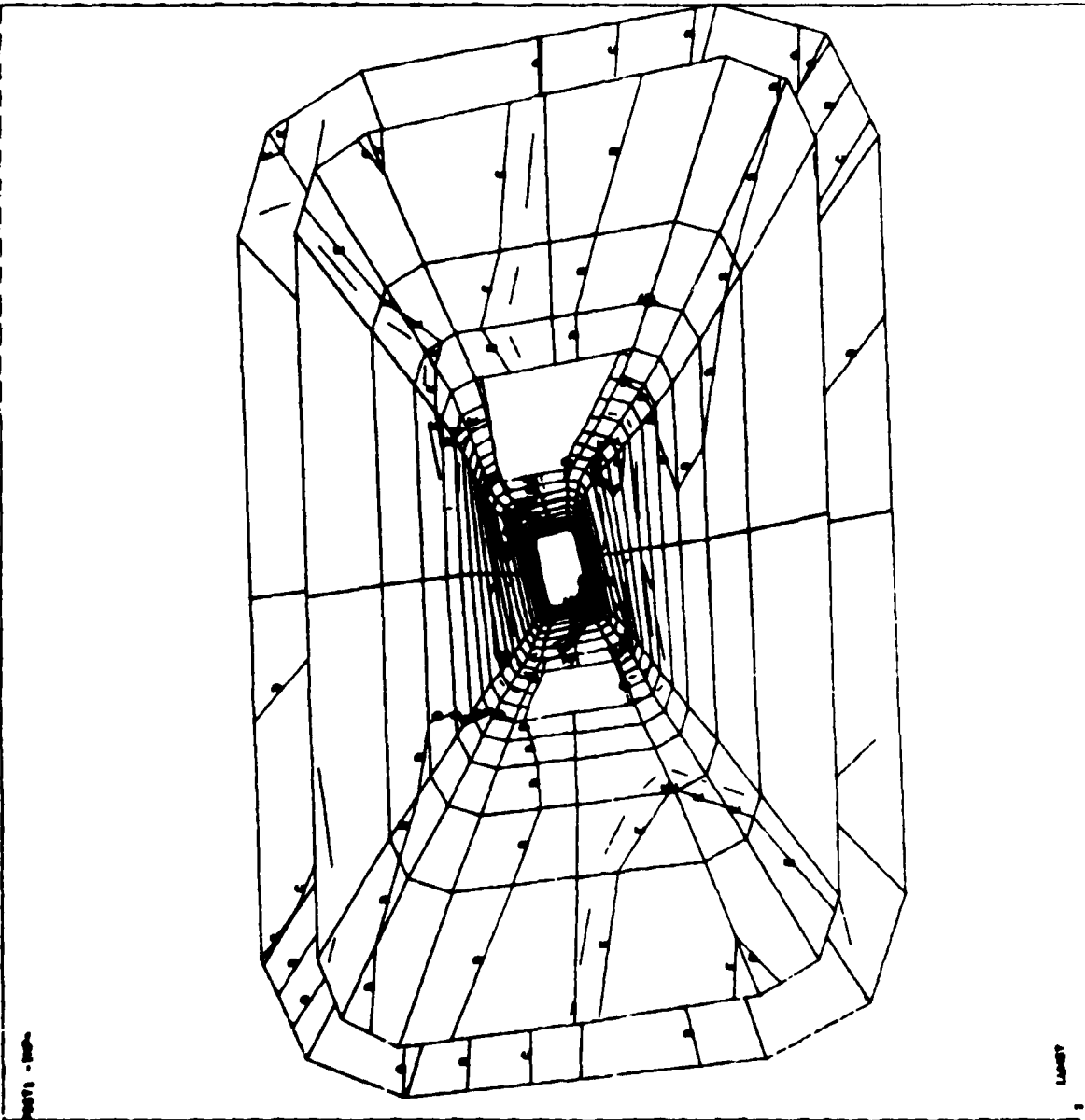
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Answers 1-10

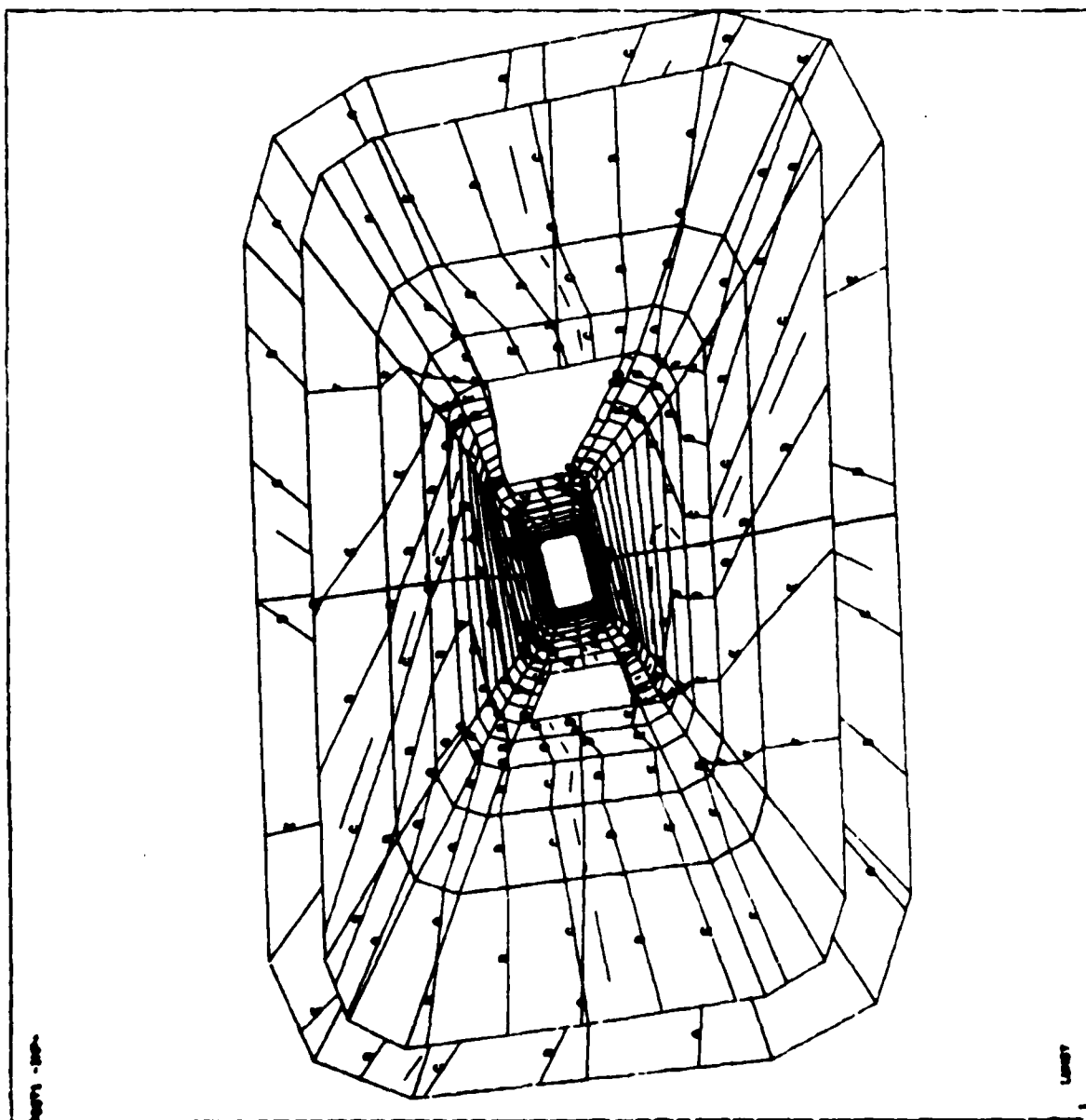
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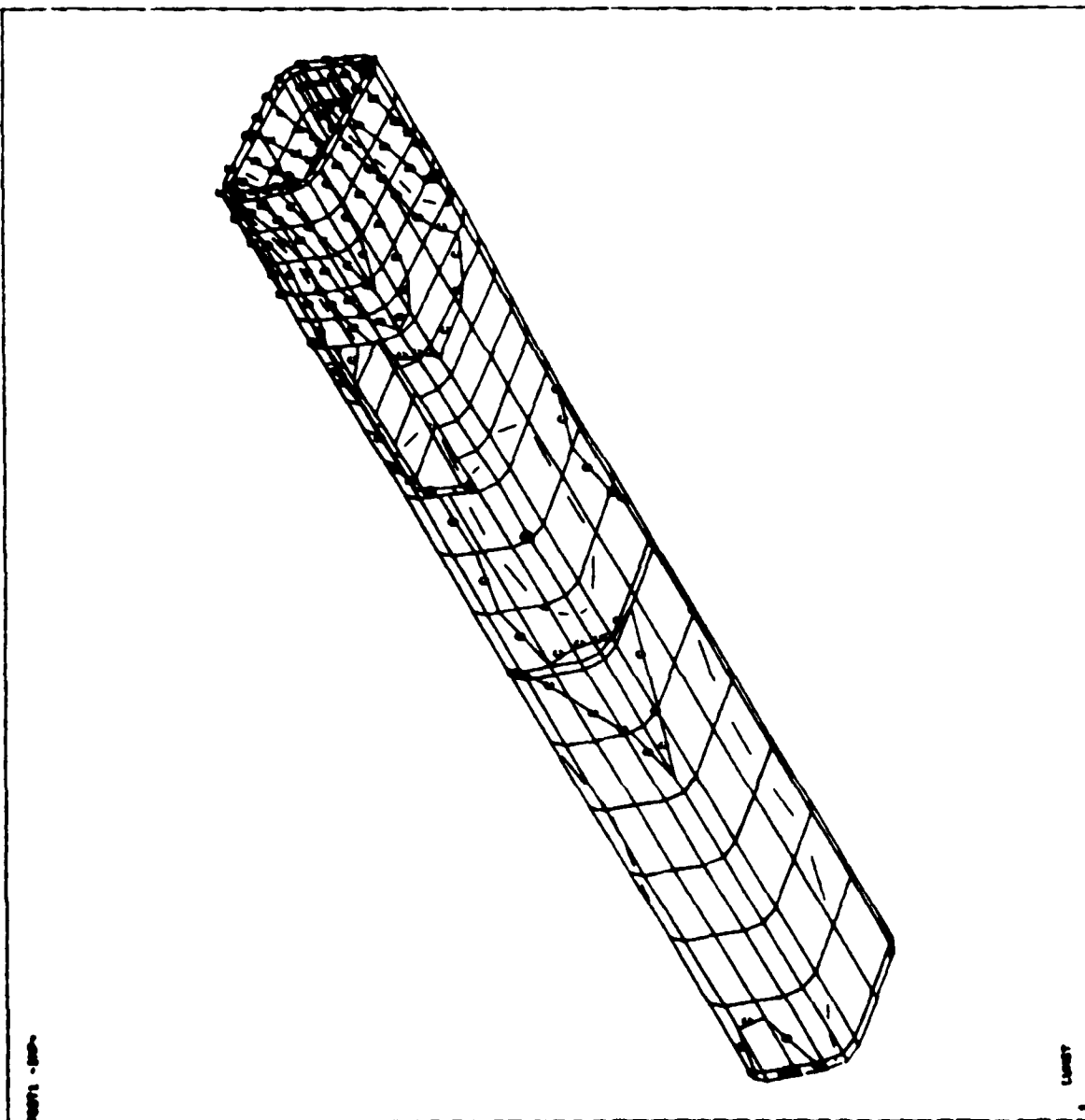
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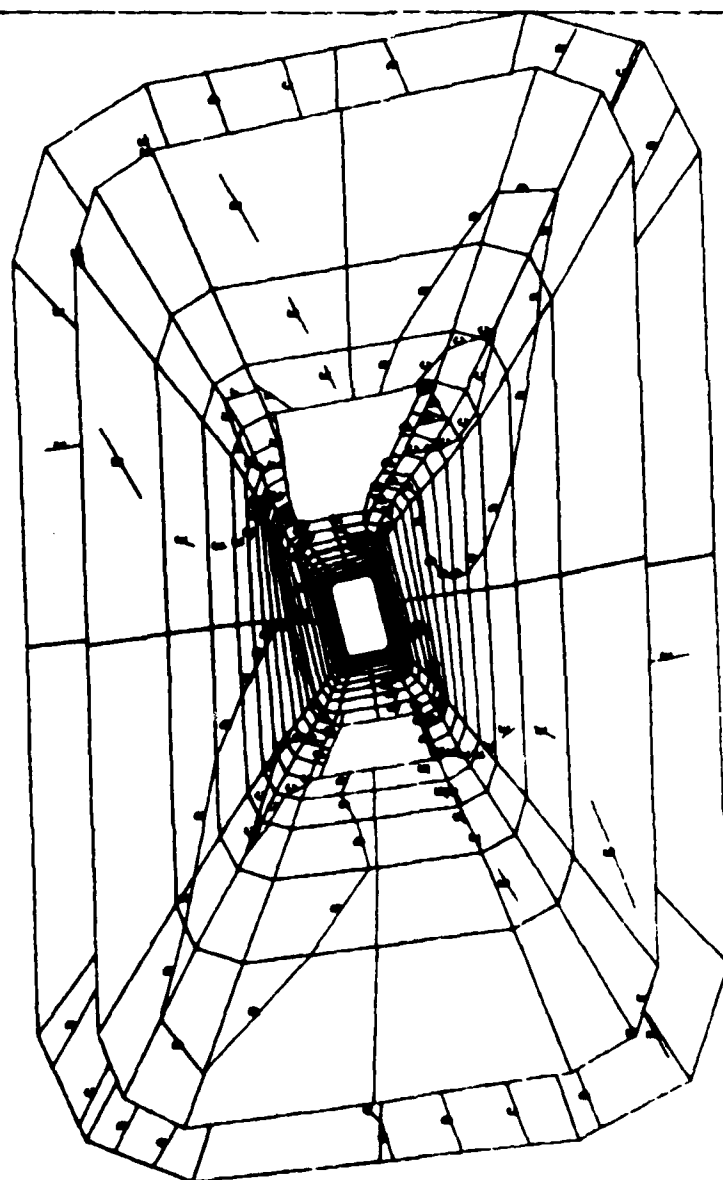
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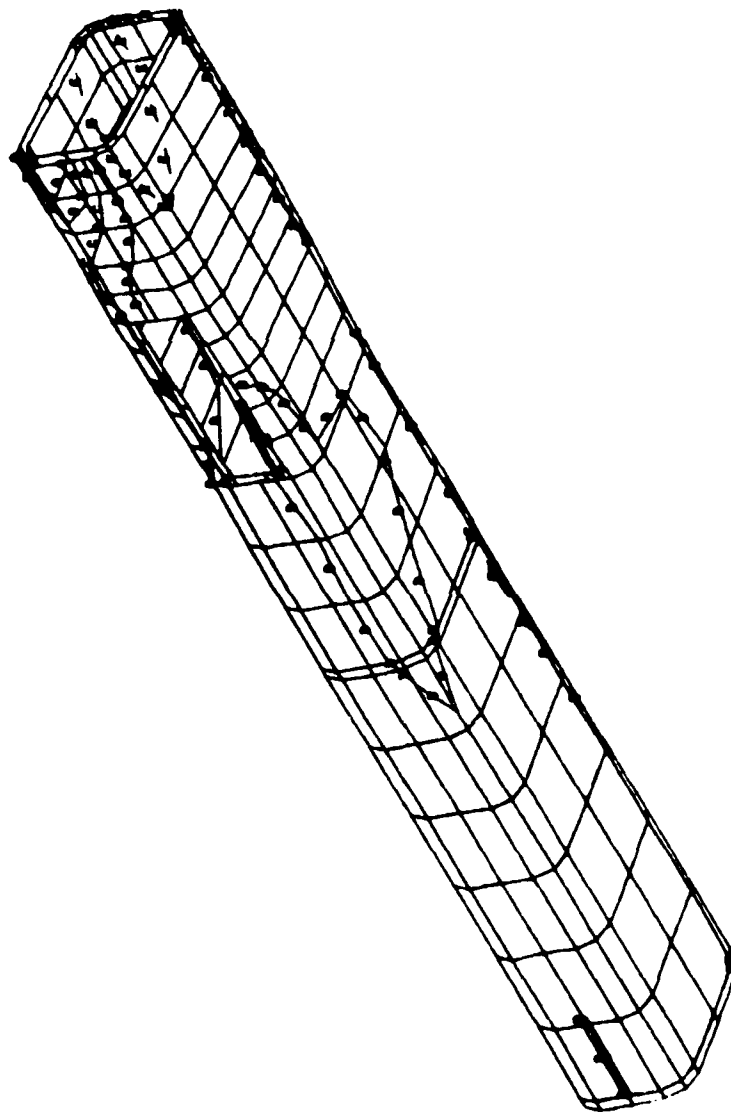
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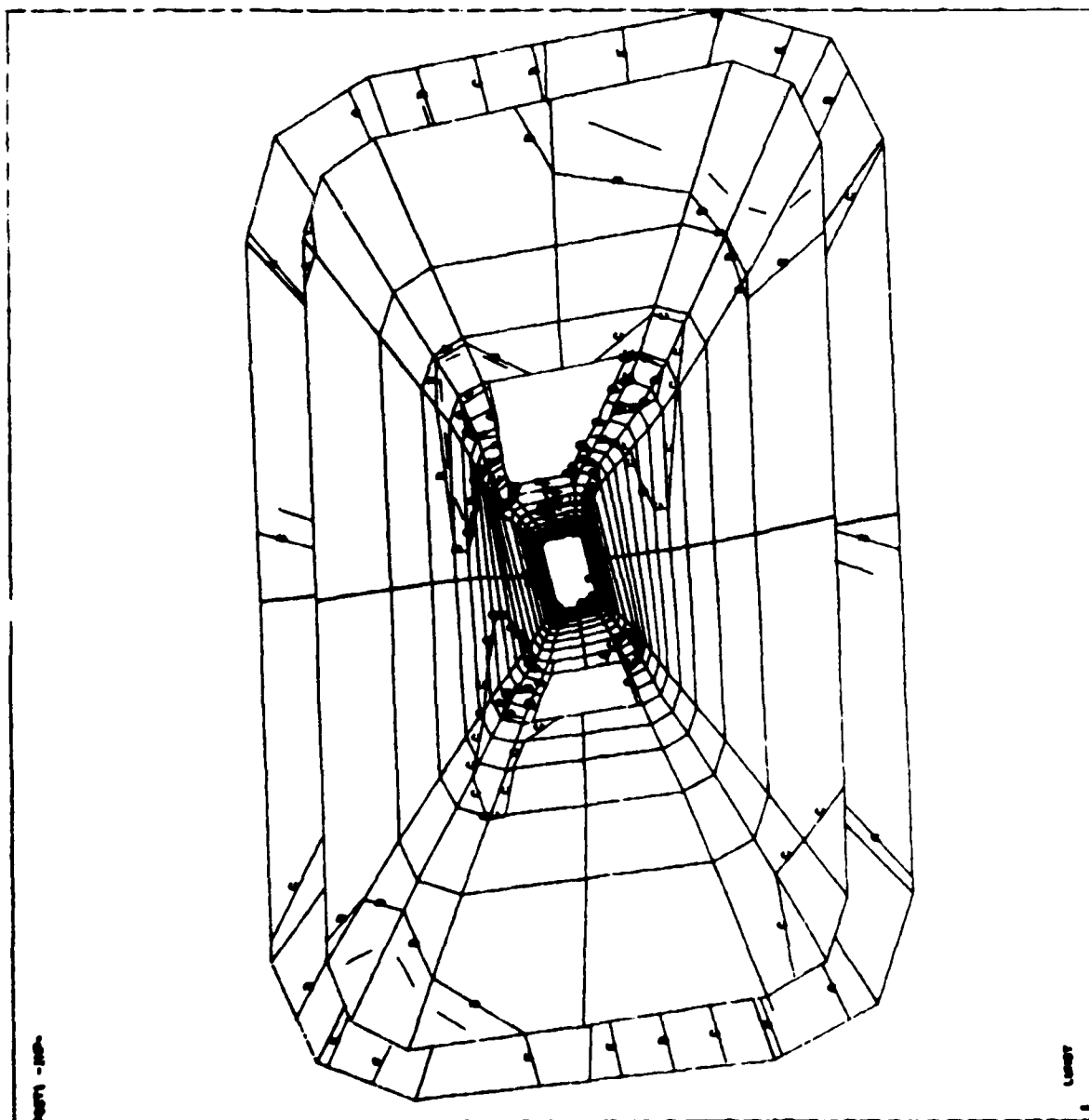
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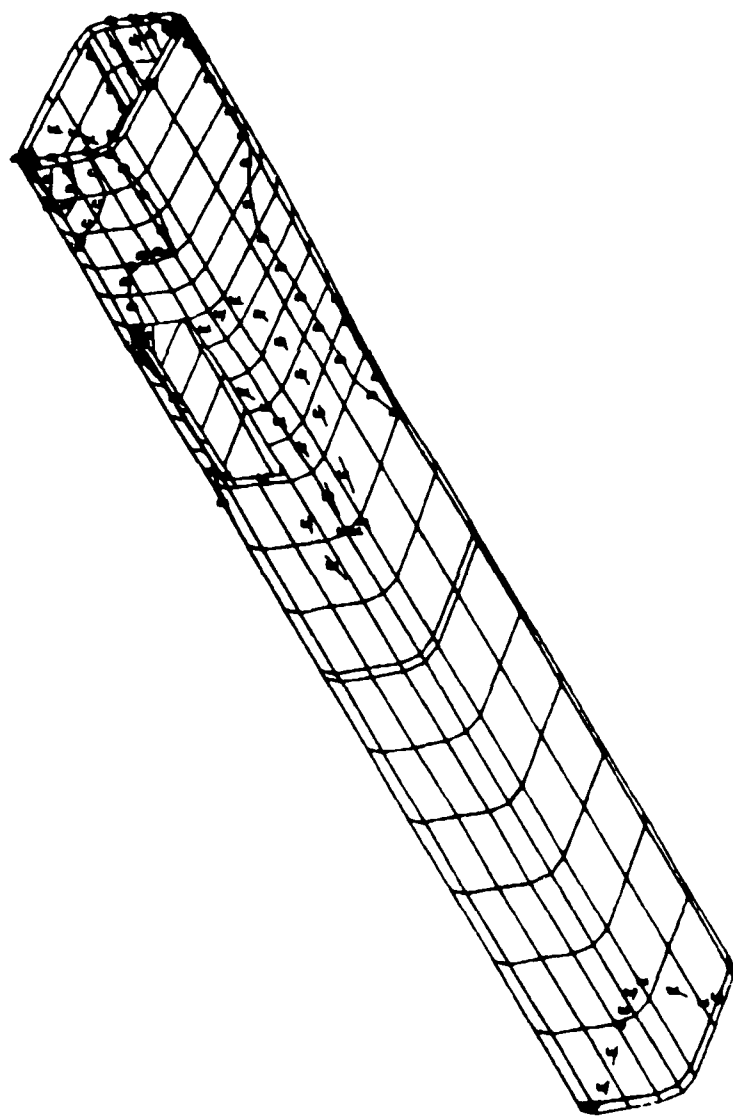


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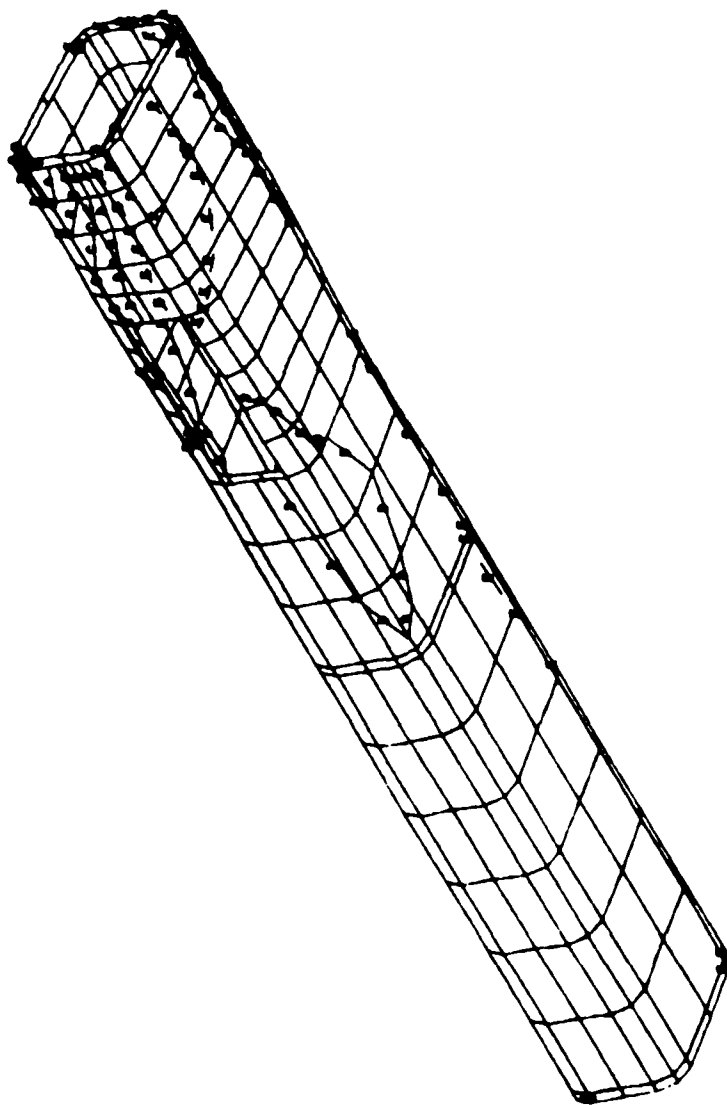
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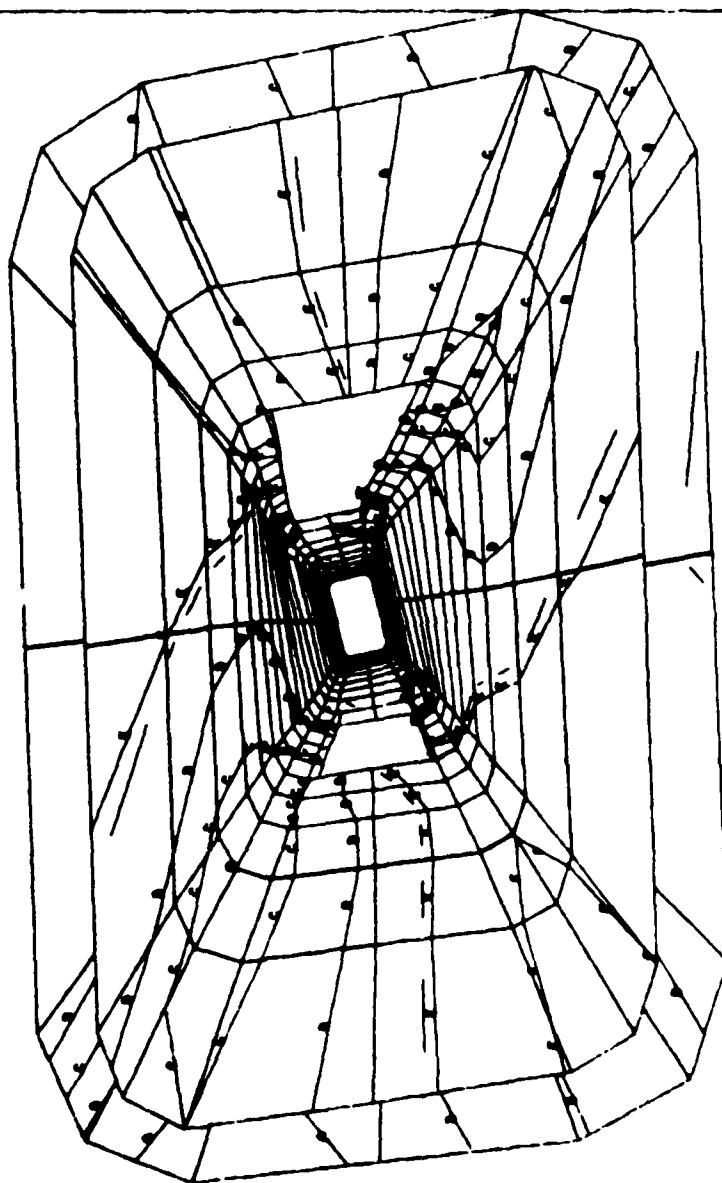
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12-15671



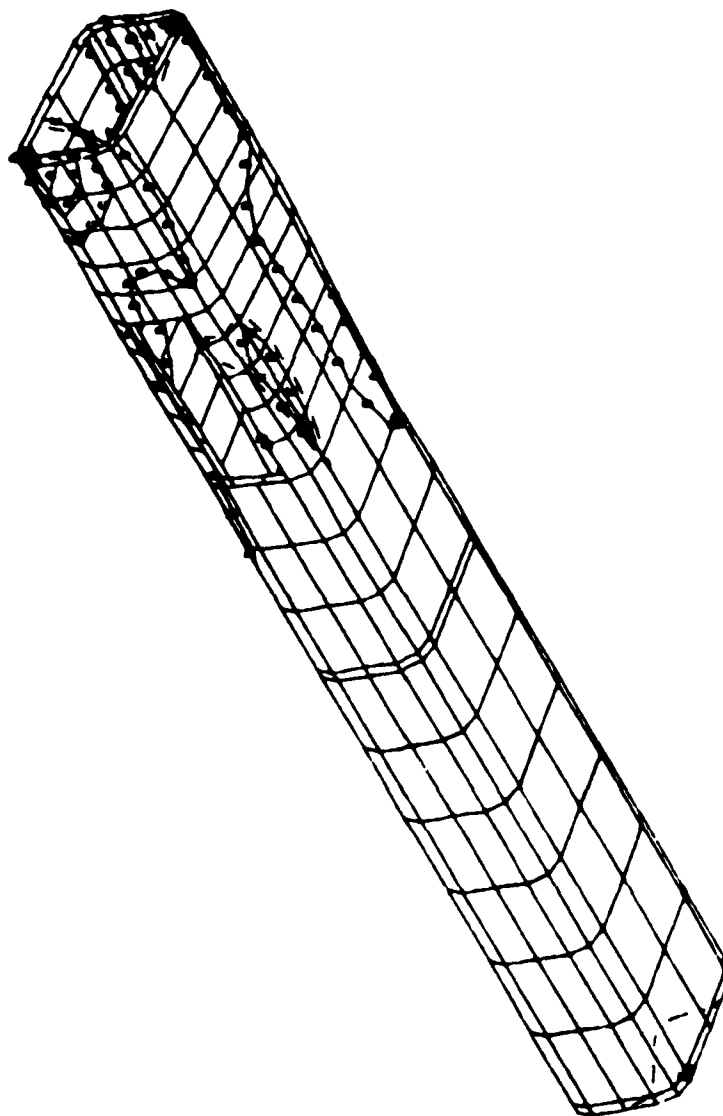
Answer

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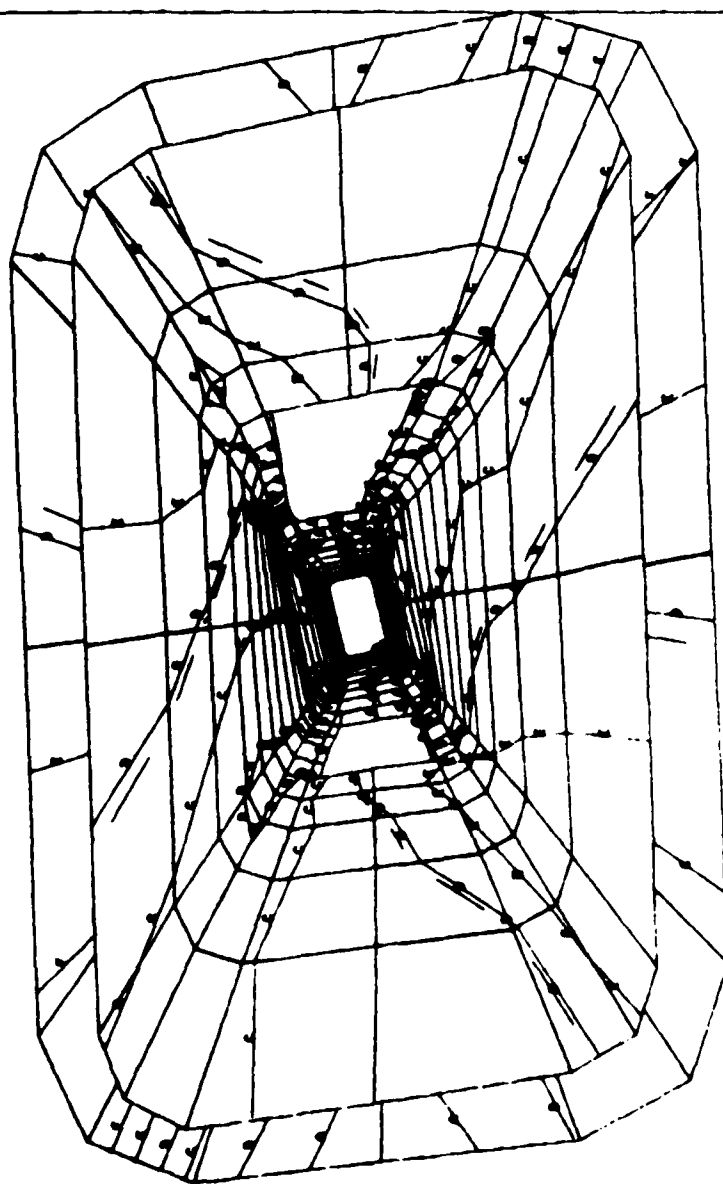
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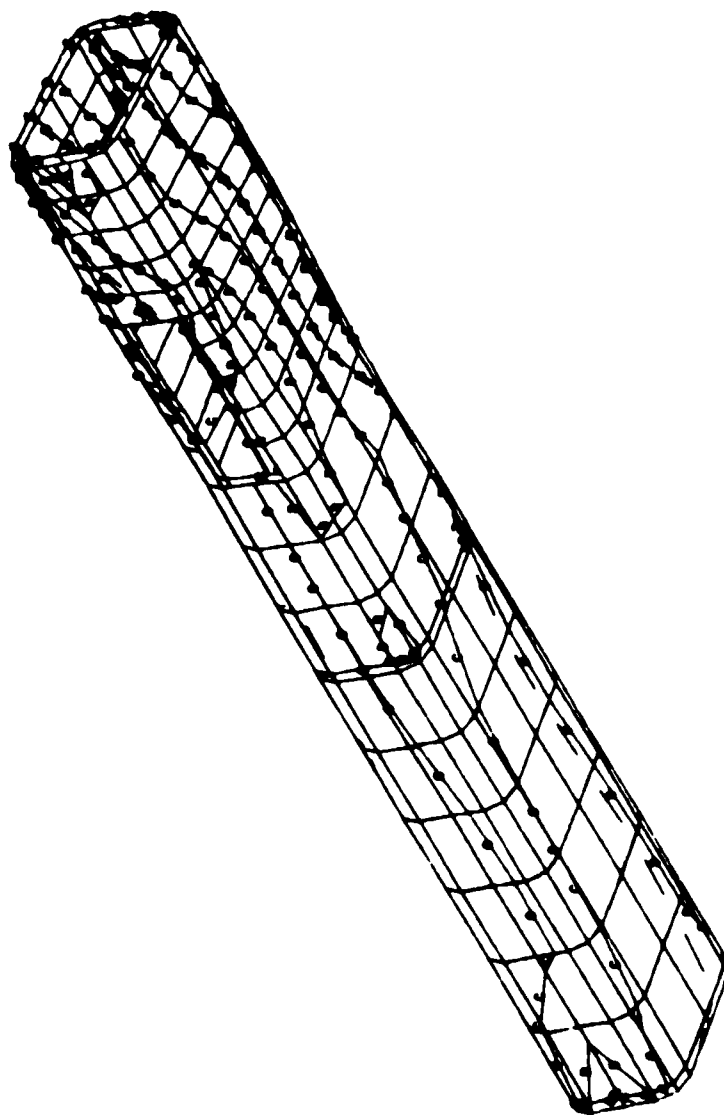
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1-2-1968



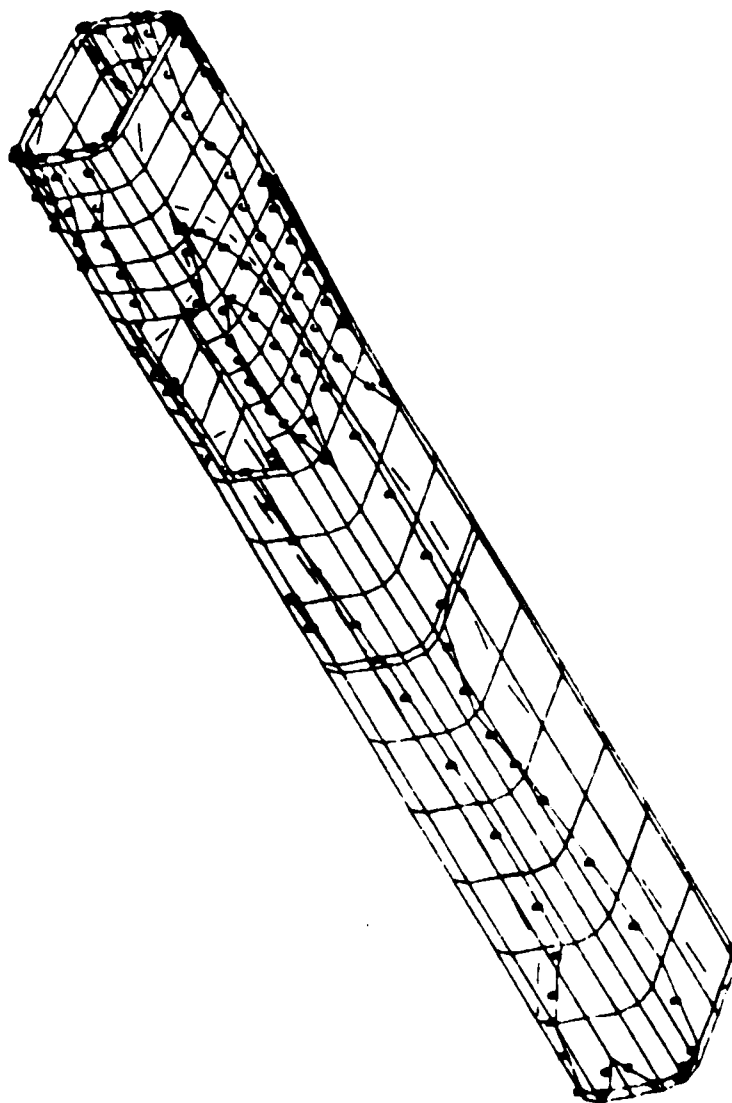
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SECRET



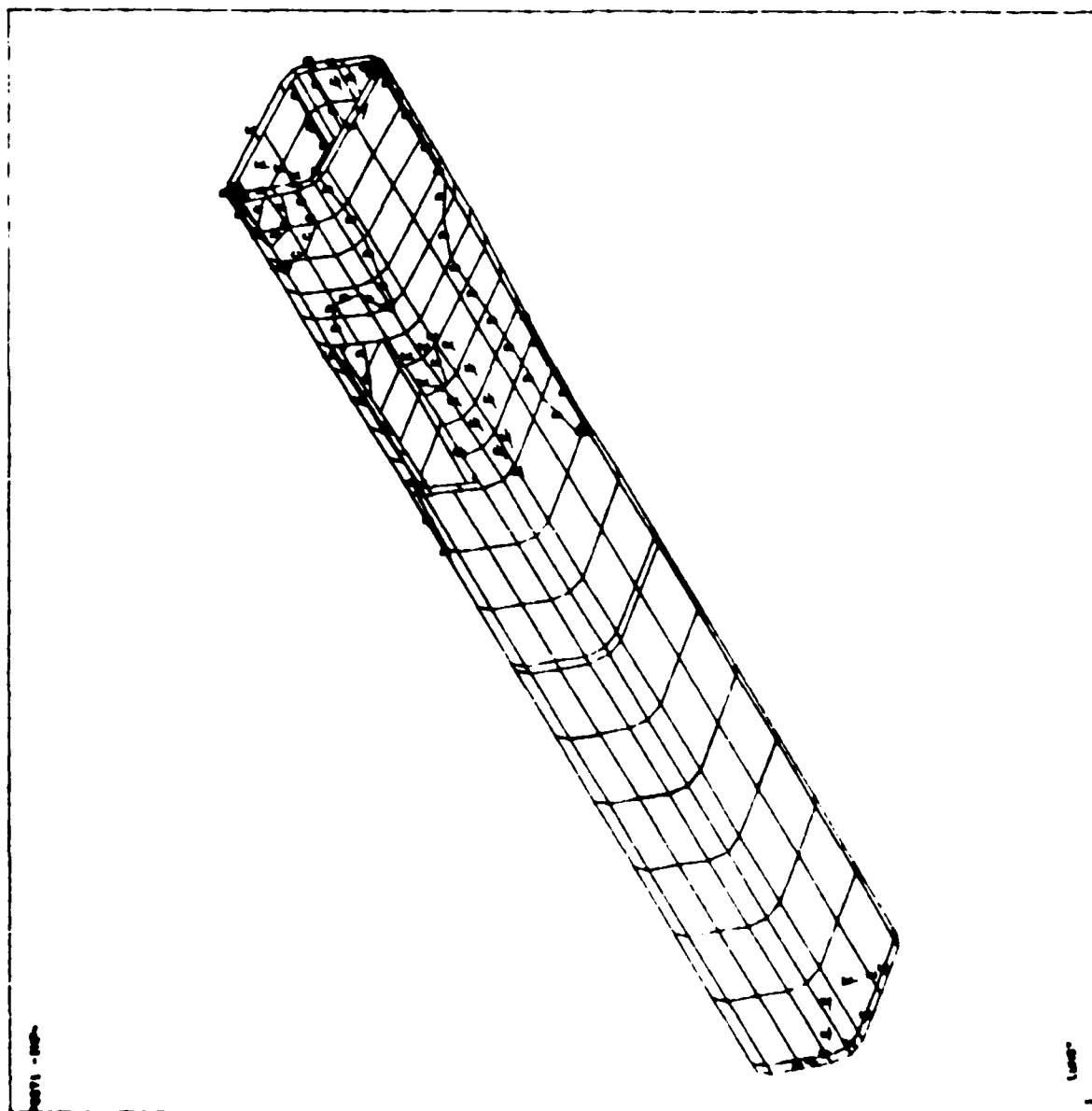
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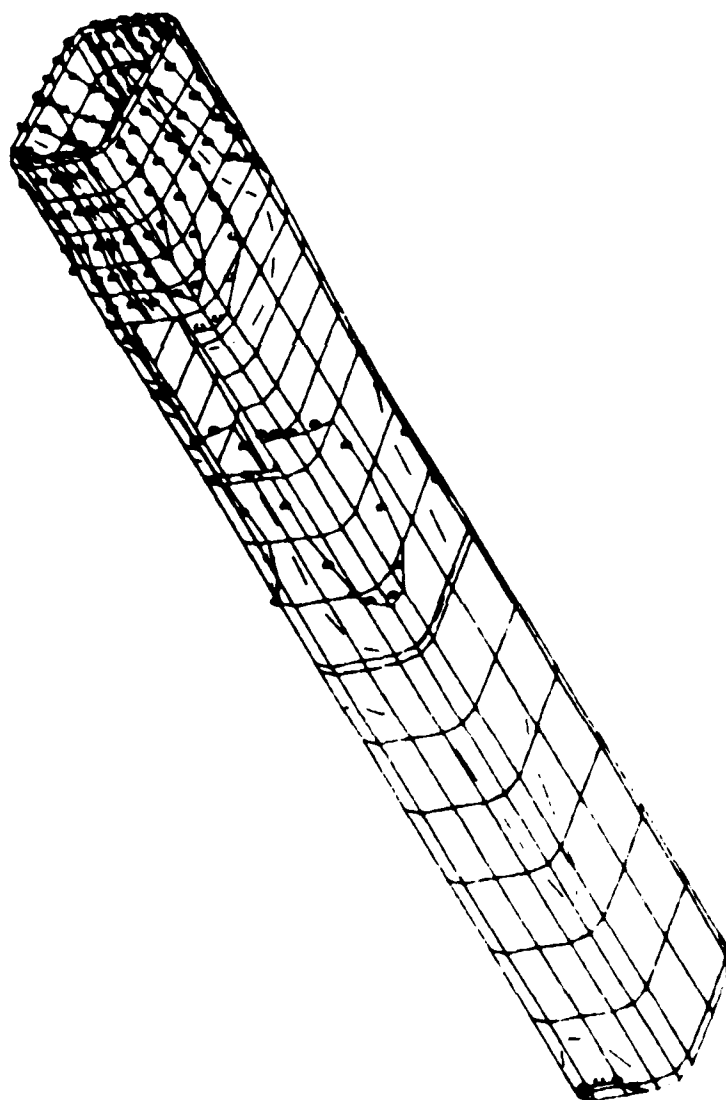


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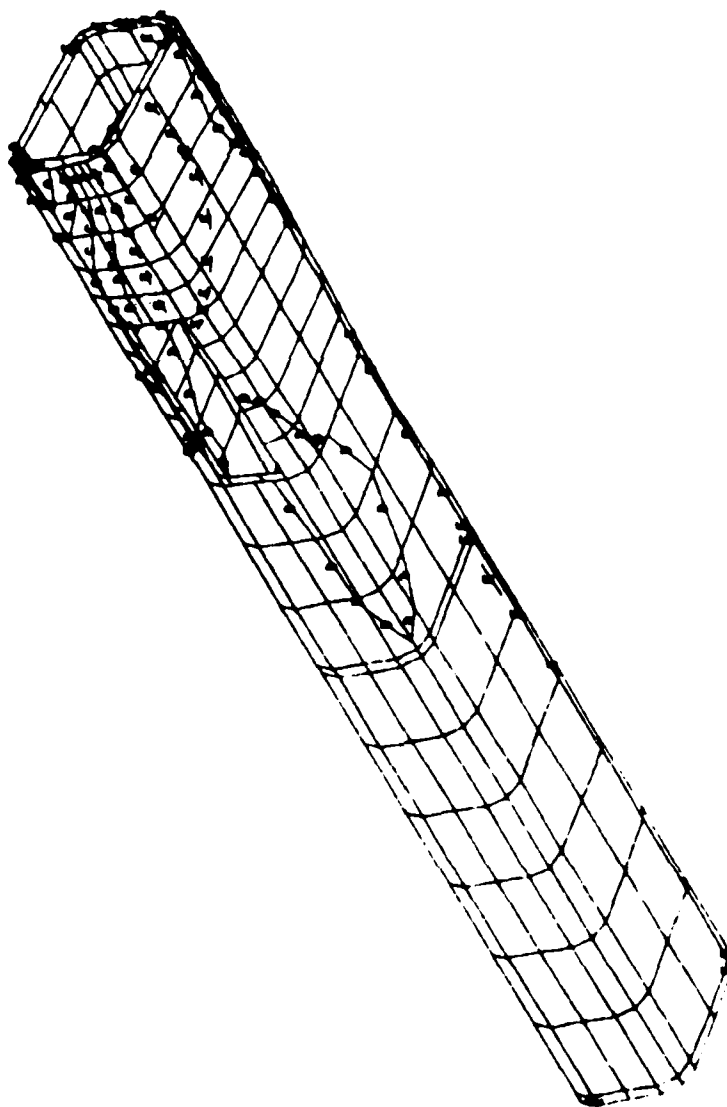


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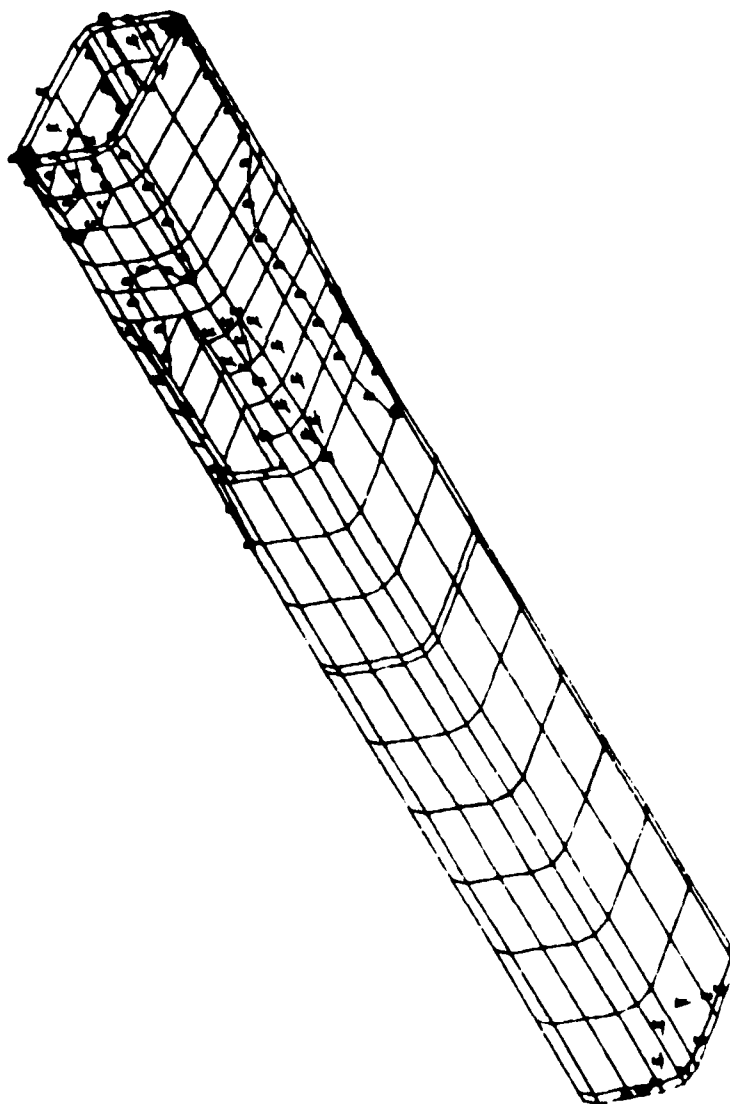
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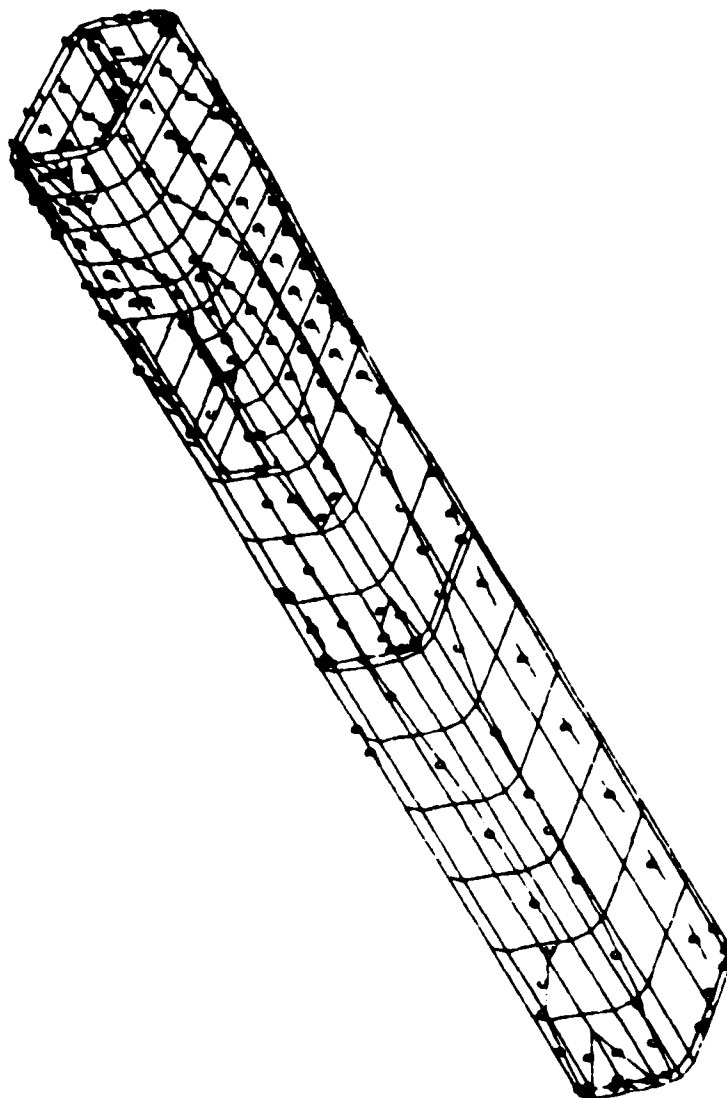
1. Introduction

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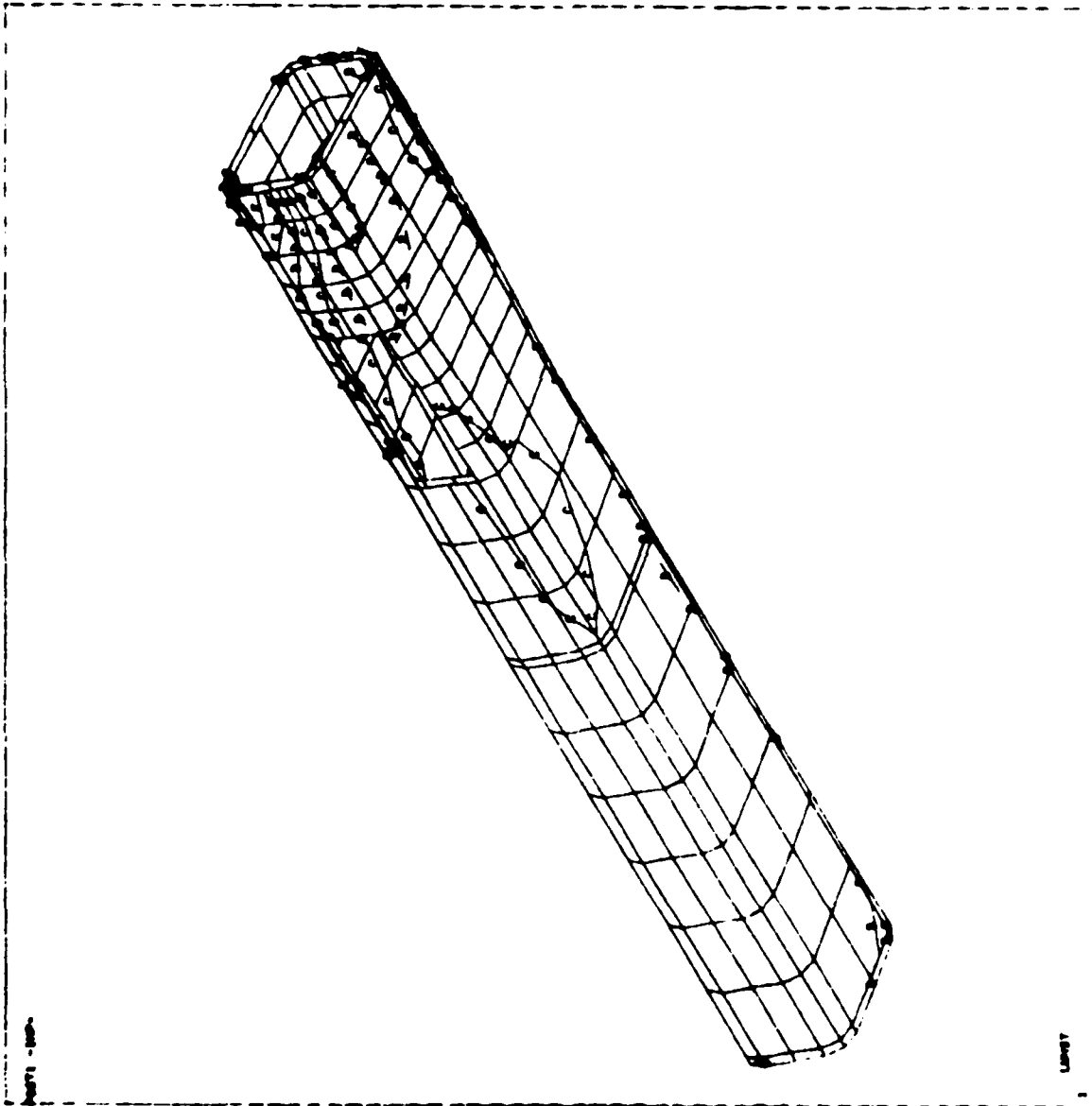
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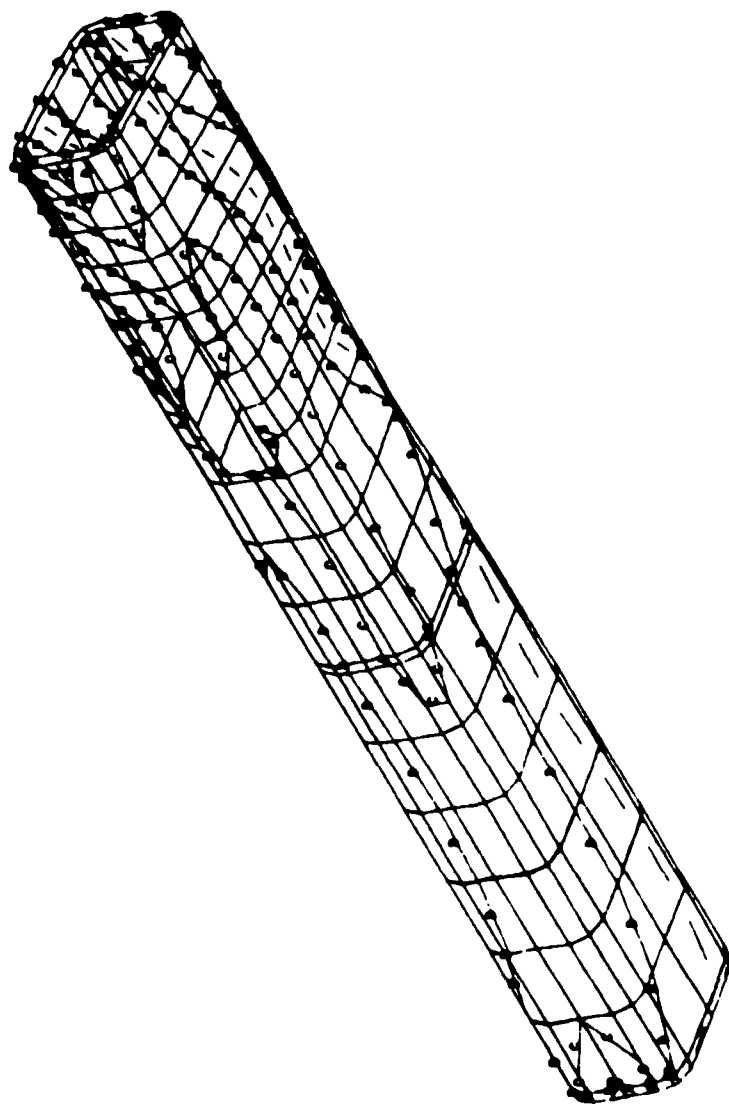
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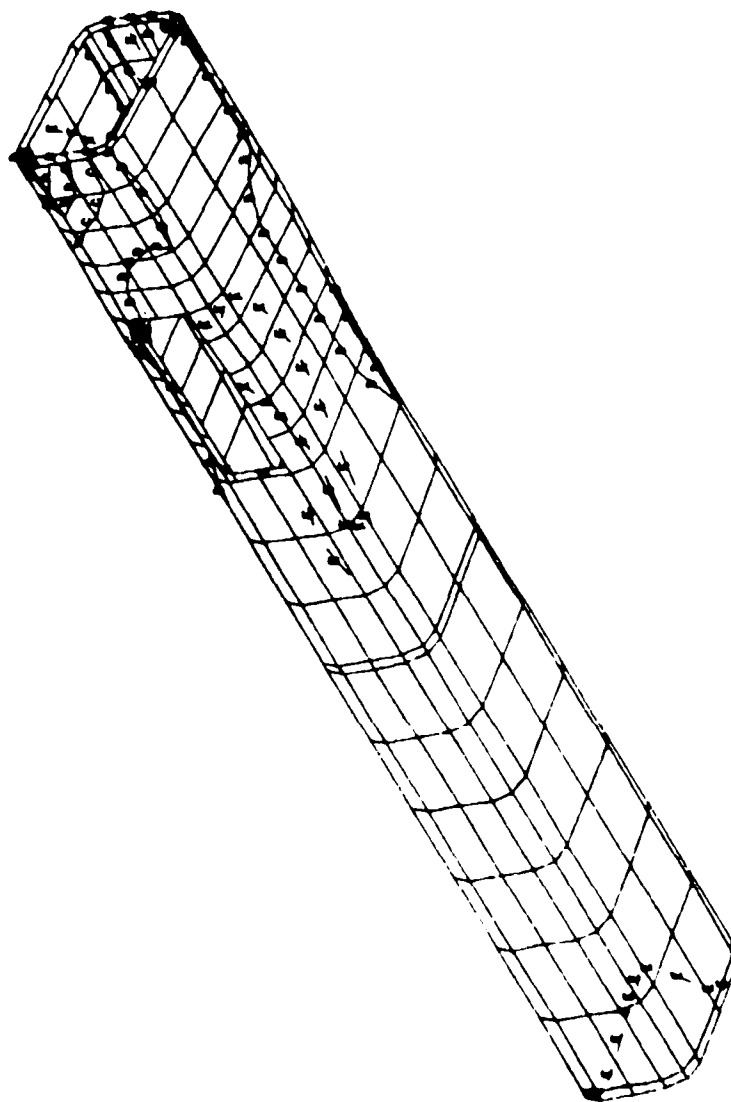
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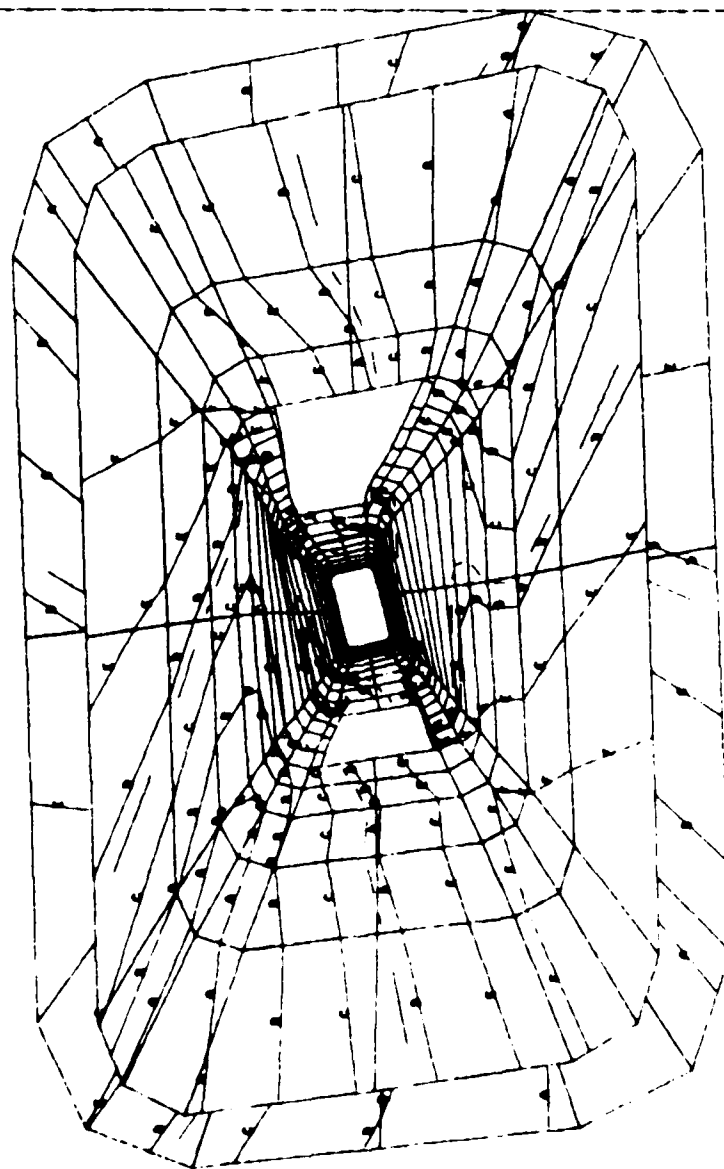
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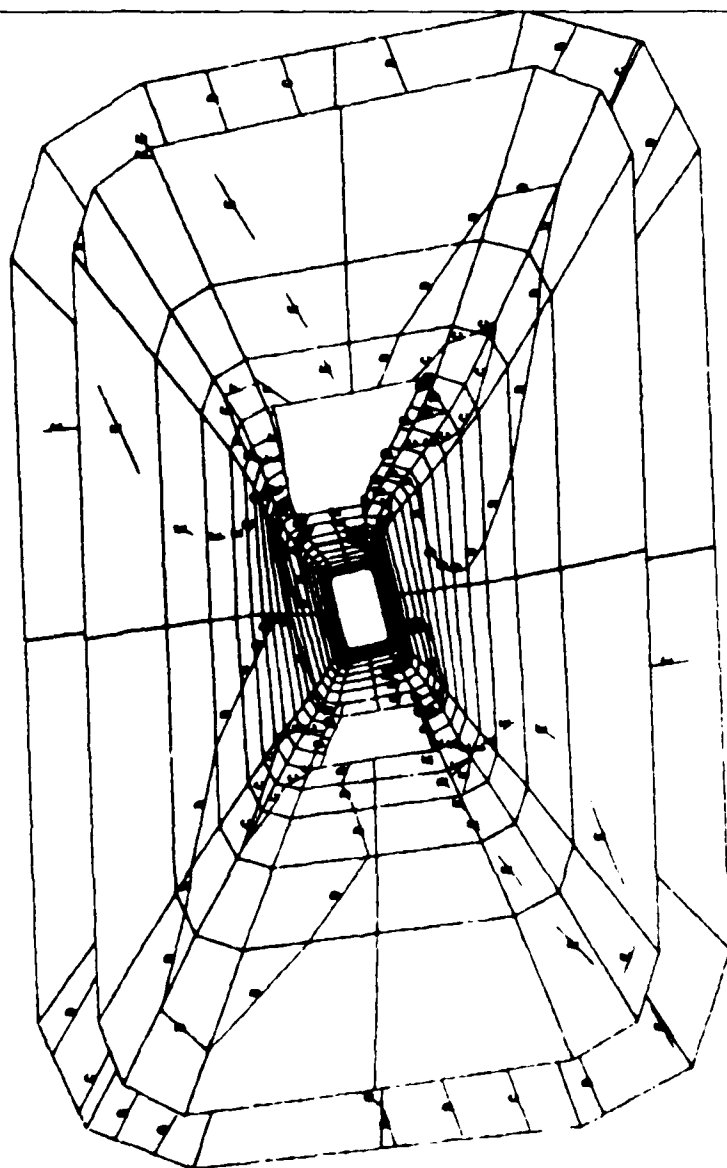
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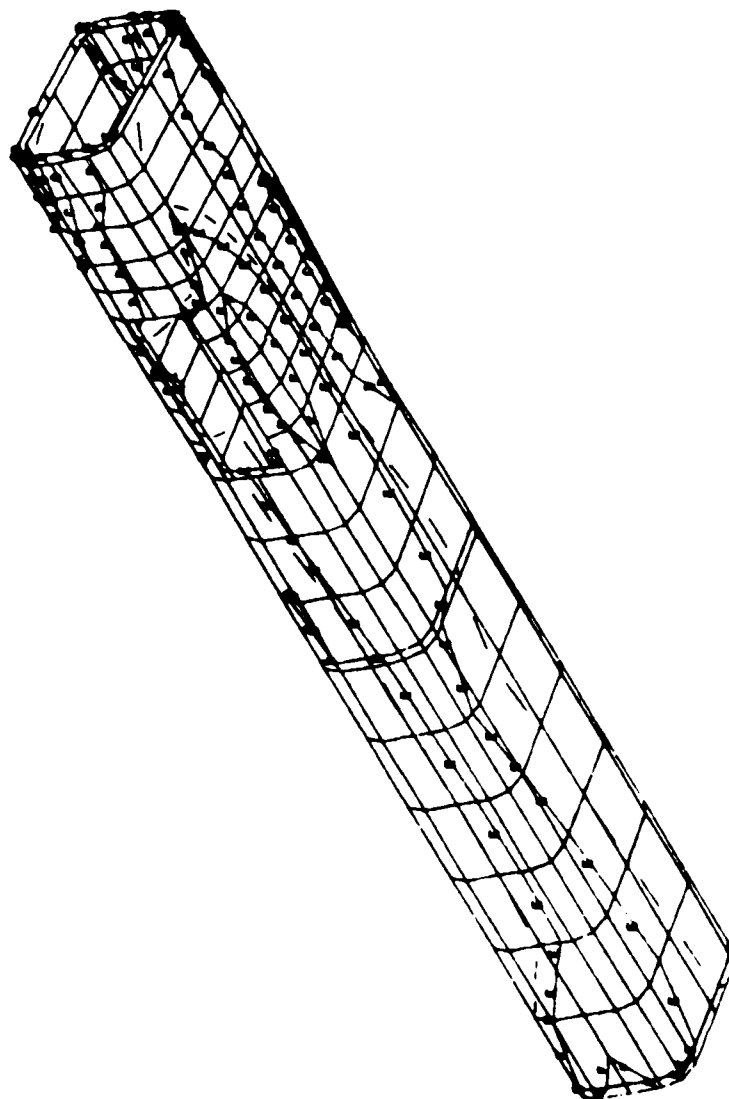
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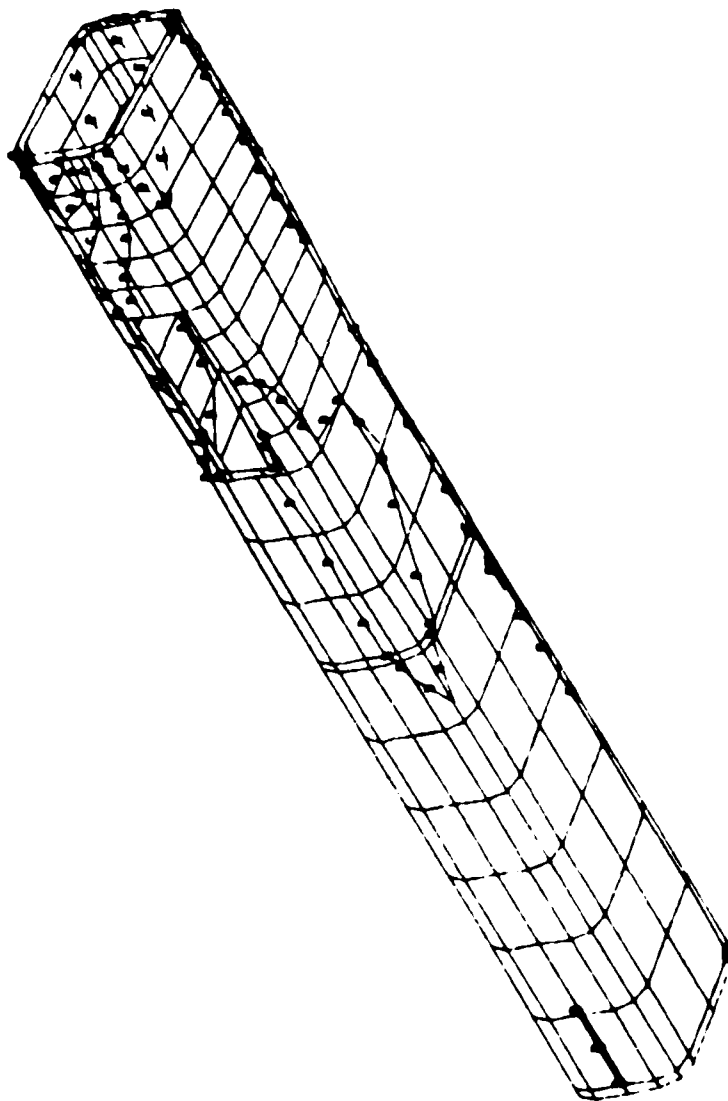
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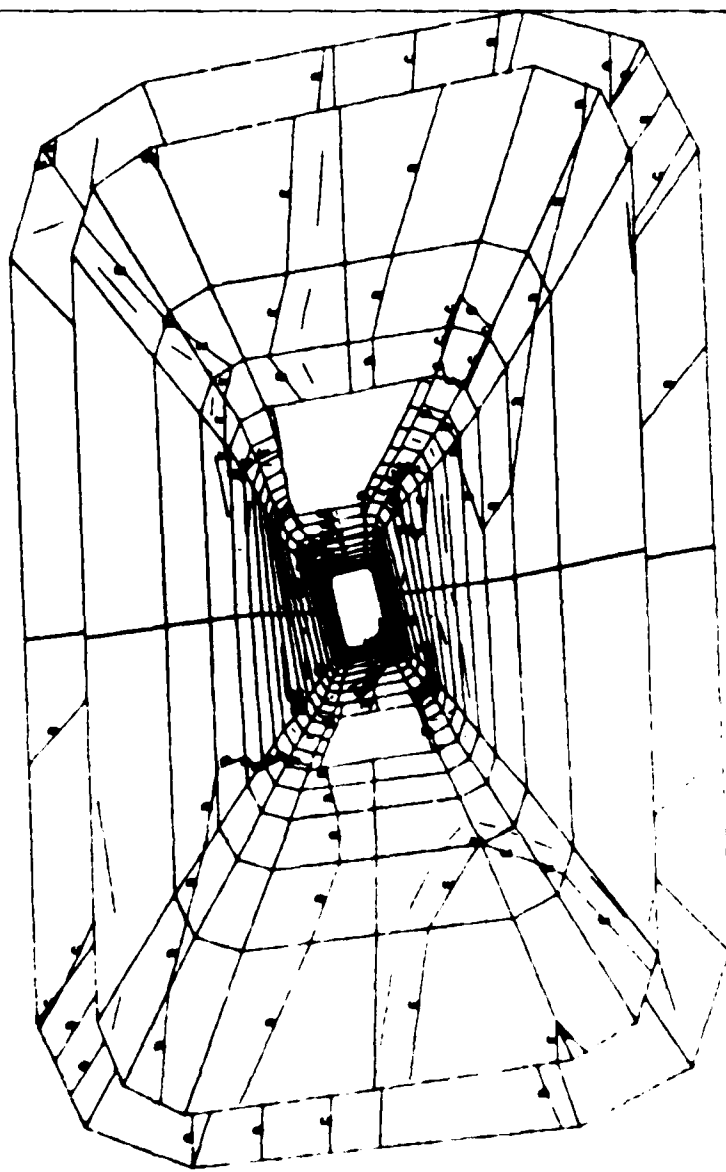
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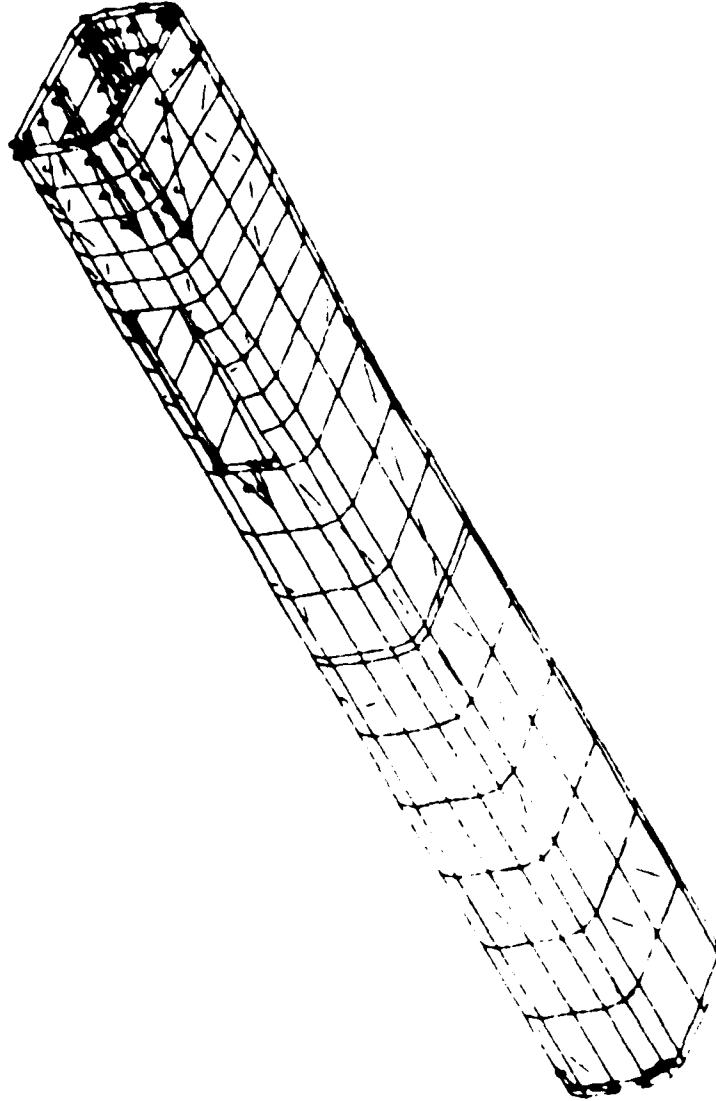


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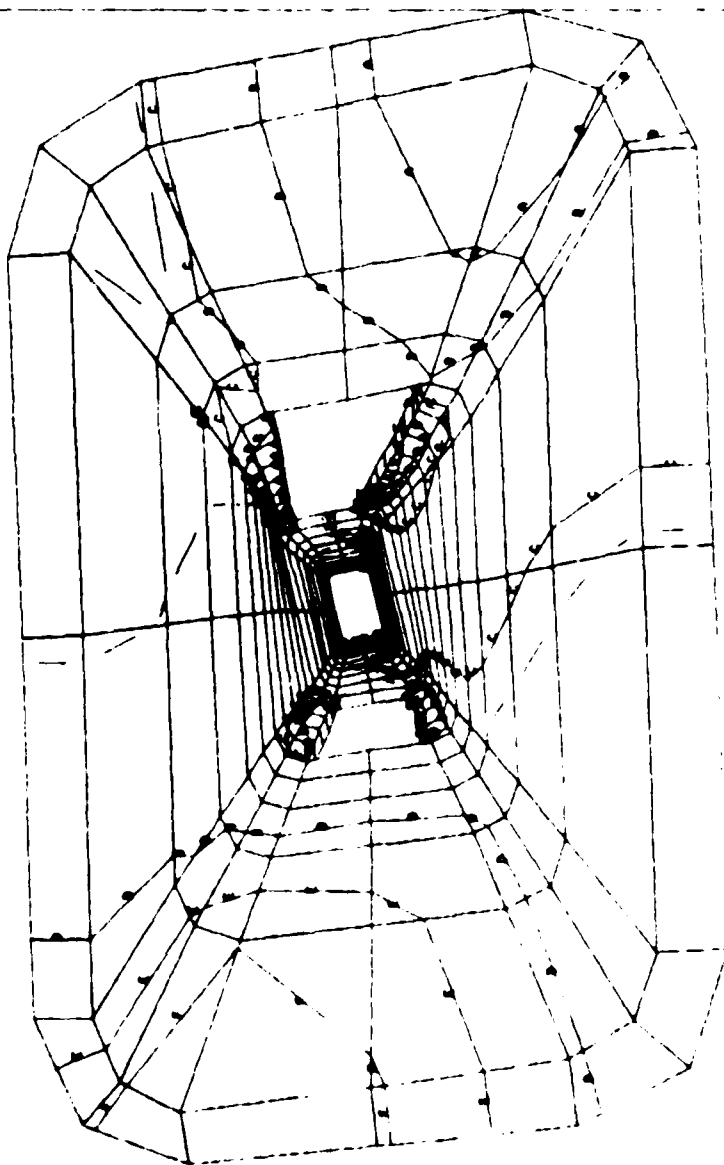
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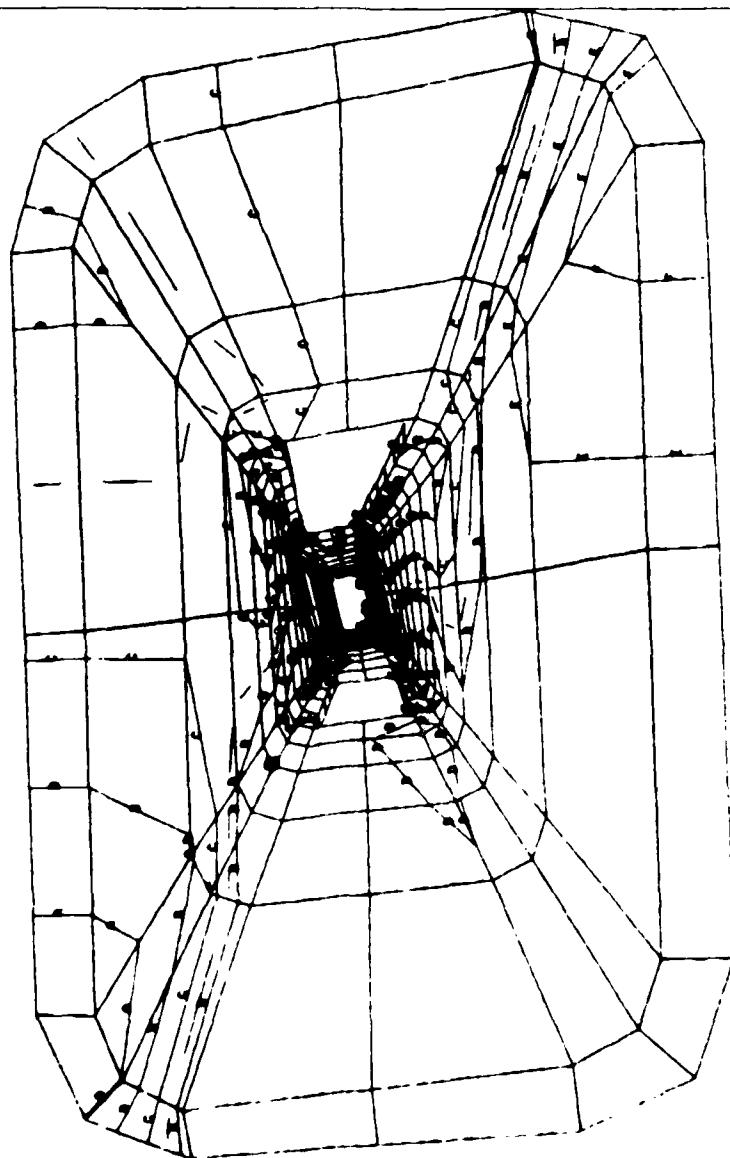
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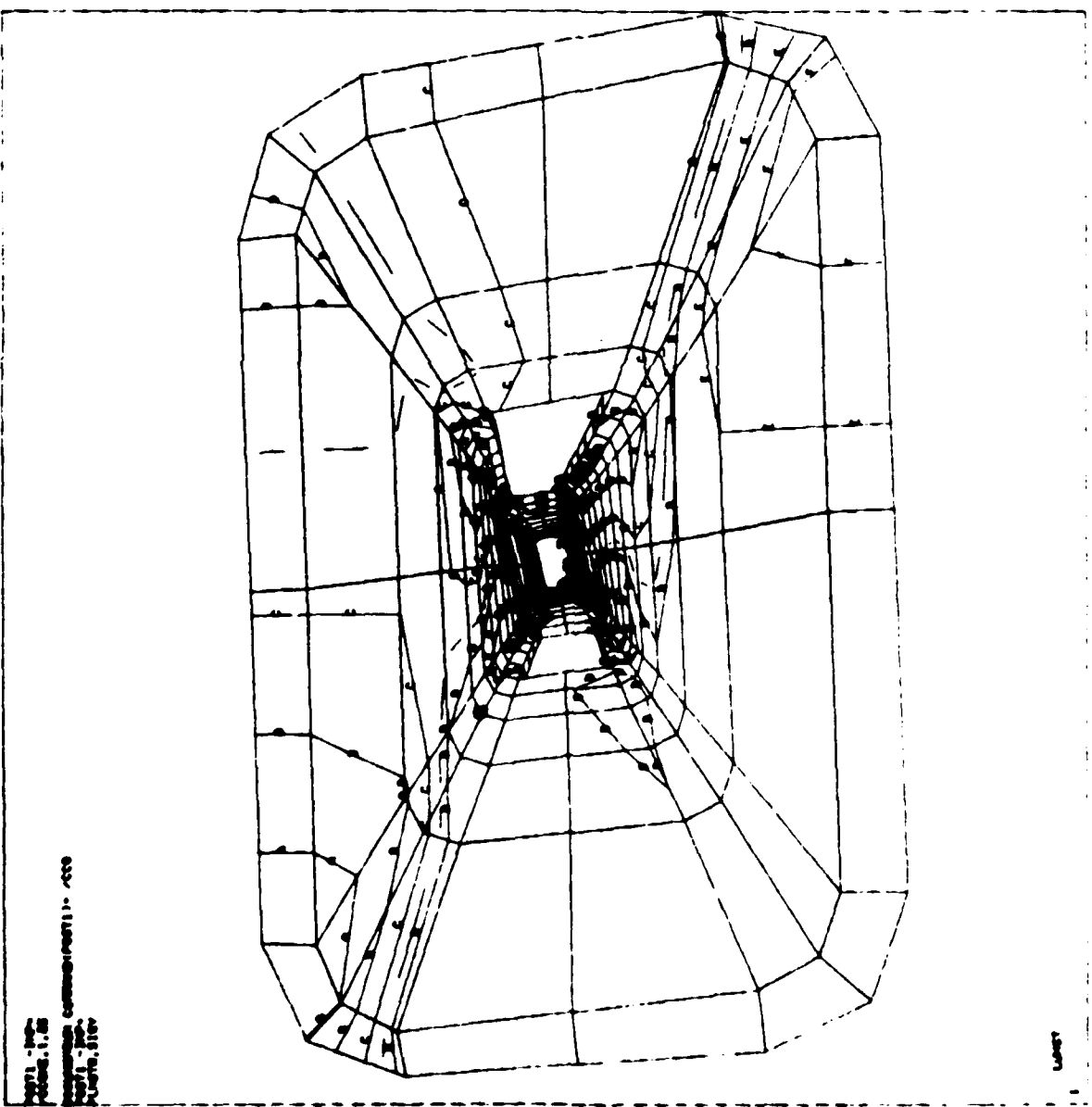
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WISCONS
AM-31.0
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D-0-16
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D-4-06
C-0-14
D-0-04



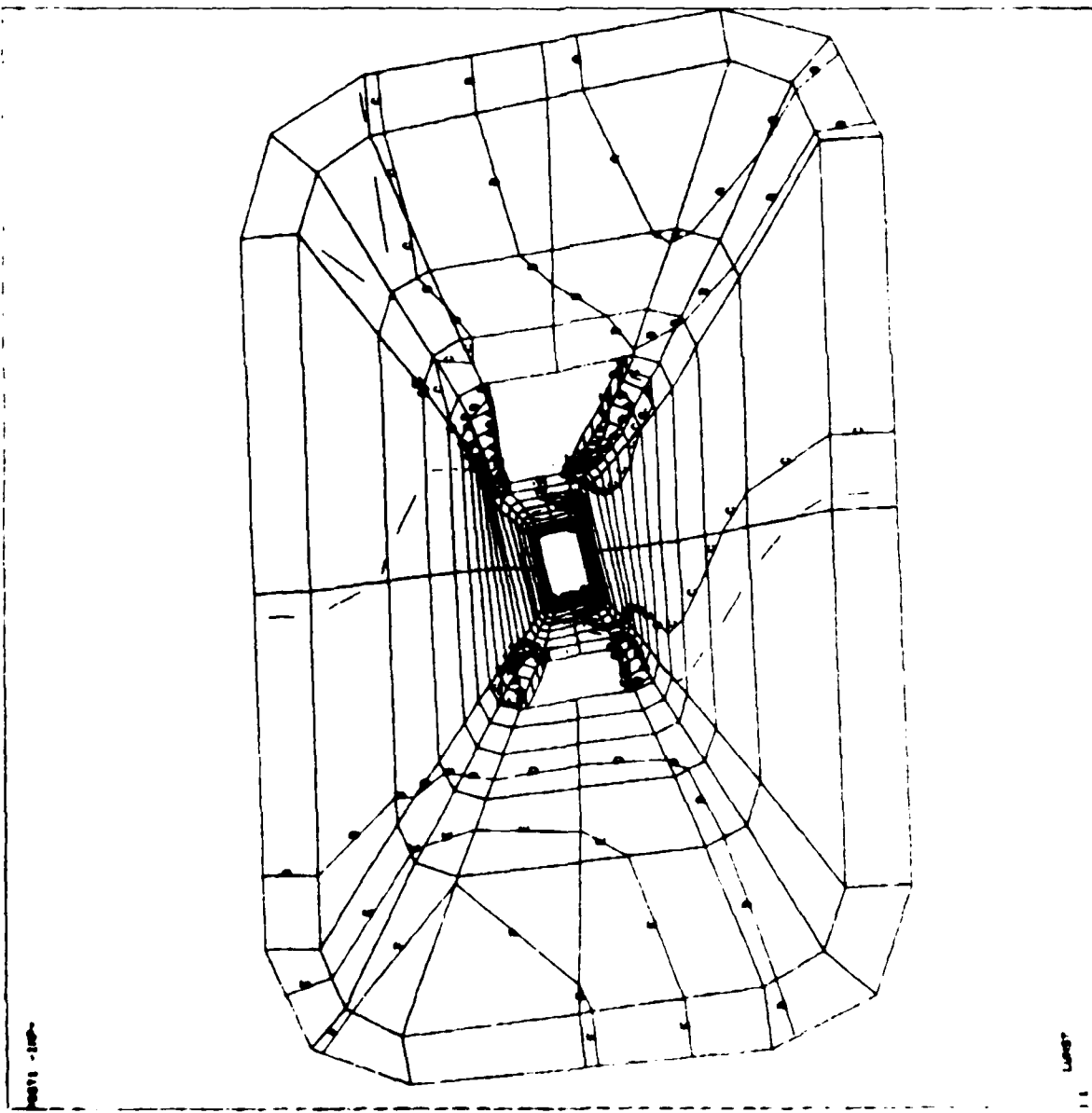
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CEL MEMO: NOVEMBER 25, 1986

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FMC Central Engineering Laboratories
Santa Clara

Interoffice

*Libbyvolt
copy*

To R. Rathe

From C. R. Ortloff

Subject **STATIC ANALYSIS RESULTS FOR
THE LWHD COMPOSITE CRADLE-PROOF LOAD CONDITION**

Date Nov. 25, 1986

cc J. Ries*
A. Amberg
R. Kazares
E. Thuse
B. Anderson
E. Alexander
B. Zierwick

*one copy of figures only.

Attached are Figures 1-81 showing the static stress state in the composite Gr/Ep cradle FE model under proof loads. Use of 20-node solids (ANSYS STIF 95) and 8-node composite elements (STIF 91) are employed to examine stresses in each of the 28 Gr/Ep lamina and the internal core material. The recoil, firing torque and gravity loads are applied statically to the cradle. The dynamic load case results (to follow shortly) model the cable tension relaxation effect and dynamic input loads precisely. Results from the dynamic run (due 12/1) should provide the appropriate dynamic amplification factor (from 0.5 to 2) for displacements. This factor may then be used with the present static stress case to determine the dynamic stress state multiplication estimates based on ratio of dynamic to static deflections.

Materials properties have been changed to reflect new values provided on 11/13. Although a new cradle design was provided on 11/13, the present results reflect the old design prior to this date. Results should be close as the geometry changes between old and new designs are minor. The new FE model used for dynamic analysis has been upgraded to reflect the new design geometry but uses CMAP averaged equivalent layer properties for the composite shells. Consequently, only "averaged" stresses in the outer Gr/Ep layers can be determined rather than individual layer stresses. The displacement-time history, however, should be reasonably accurate and suitable for use in determining a stress amplification scale factor. No thermal expansion or moisture absorption loads are included in the analysis and proof firing load maximum amplitudes are used. The distributed masses of the gun barrel and cradle plus the concentrated mass of the hydraulic cylinders and equilibration device is also included.

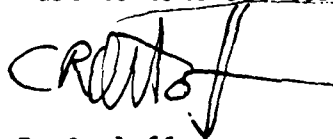
In the output, UY represents vertical deflection, SHL represents in-plane lamina shear stress, ROTZ represents rotation (radians) about the longitudinal axis, SXL is the fiber stress, SYL is the transverse fiber stress (epoxy) and L represents the layer number starting from the outer layer. Note that layer 1 is the outer layer for the Gr/Ep shells; layer 14 is the Gr/Ep layer closest to the core for both inner and outer laminates.

Preliminary results are summarized below for the static stress case. These results will be updated when results from the dynamic analysis when available.

- o Maximum in-plane lamina SXY (SHL) stress for the entire cradle is less than or equal to 6,000 psi (except for regions near the composite to metal attachments near the gimbal mounts). Allowed stress is 10,000 psi. Allowing for a total 2X factor due to thermal expansion effects, moisture absorption loads, local manufacturing defects and assuming a dynamic amplification factor greater than unity (or a stress safety factor (SF) of 2), SXY shear failure may be anticipated in layers 1, 2, 4, 5, 8, 11.
- o Maximum interlaminar shear stress for all elements is less than 100 psi consistent with the plane stress assumption used in STIF 91 formulation. Allowing for a factor of 2 for the above-mentioned considerations (or a stress SF=2), this stress is still less than the epoxy shear failure stress of 10 ksi.
- o Maximum longitudinal deflection under combined firing loads and gravity loads is about 4 inches vertical. This deflection seems excessive unless the gun rails are to be designed to provide large bending stiffness to add to that of the cradle and/or longitudinal stiffening is added to the cradle.
- o Maximum cradle rotation is about 4.0° end-to-end. As the cradle is relatively flexible in torsion, additional +45° layers in the region between the last internal plate and trunnion may provide additional torsional stiffness.
- o Maximum fiber stress (SXL) in regions away from the end connection region is about 120 ksi (Layers 6,7,13 for example). Allowing for a 2X factor for the above-mentioned effects (or a stress SF=2), stresses approach 240 ksi, and exceed the allowable stress of 180 ksi. Local fiber failure may be anticipated in a compressional mode.
- o Numerous cases exist for epoxy stress on the order of 5,000 psi (layers 2,10 for example) well away from the end connected to the gimbal mount. Allowing for a 2X factor (or a stress SF=2), the stresses are on the order of the 10 ksi, resulting in local epoxy failure under proof loads. This is cause for concern using the current resin system.
- o Foam core shear stresses appear less than 100 psi under proof load conditions. Normal stresses appear less than 100 psi also. A suitable core material with failure properties above these limits can easily be found.

Preliminary Recommendations:

- o Based on the total 2X assumption for stress amplification and other factors (which will be checked when the dynamic output is available) or a stress safety factor of 2, it appears that margins of safety for stress are exceeded for both fibers and epoxy in certain lamina under proof loads. The in-plane shear stress is likewise above the failure limit in certain lamina. Local failure can therefore be anticipated inside the Gr/Ep layers. Since all of the high stress regions are located in the zone between the gimbal mount points and last internal plate, this zone may need reinforcing by additional 0°, 90° and +45° layers or internal/external bonded-on sections.
- o The deflection and rotation seem excessive. Use of additional 0° and +45° fiber layers will improve the bending and torsional stiffness considerably especially in the region between the gimbal mount points and the rear internal plate. This zone has large cutouts and shows consistently high stress values. It is anticipated that this zone will require considerable reinforcement to achieve lower stress levels.
- o Failure criteria is based on maximum stress criteria. There may be other modes of failure (such as longitudinal buckling or torsional buckling and local fiber-resin separation) not accounted for in the present analysis. These investigations will be pursued by use of ANSYS buckling routines.
- o The high stress regions near the gimbal mount are indicative of what may be expected near the metal-to-composite joint in this region. The length from the core region should be reinforced to distribute stress over the Gr/Ep face sheets to low levels. It may be necessary to build up the connection zone Gr/Ep layers leading from the core end region to avoid high stress concentrations. A separate FE analysis of this end zone should be performed.
- o An internal metal space frame within the core connecting trunnion mount end plates to the internal rear plate may be of use to take out torsional stresses in the cut-out zone.

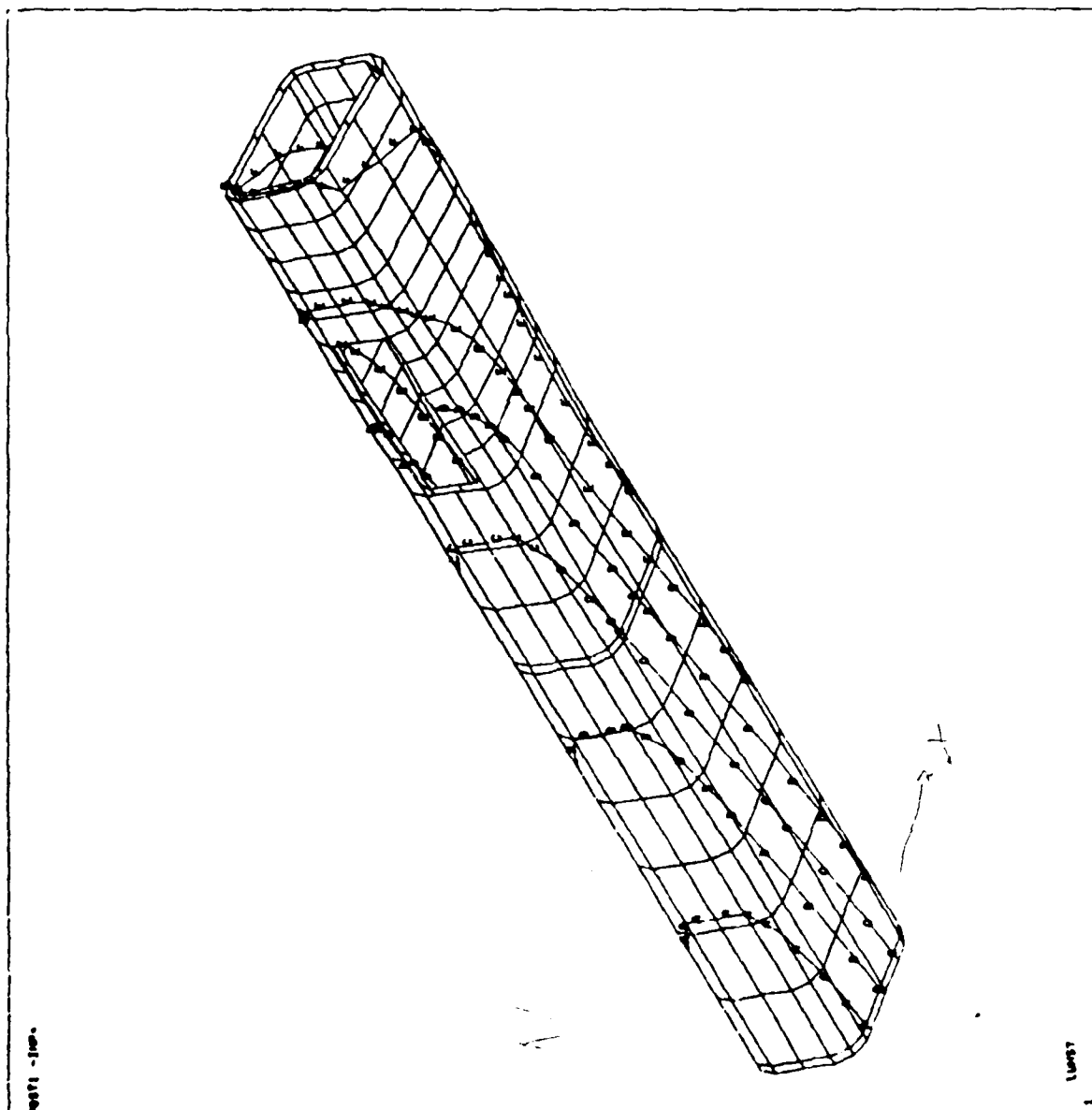

C. R. Ortloff

File 1-5

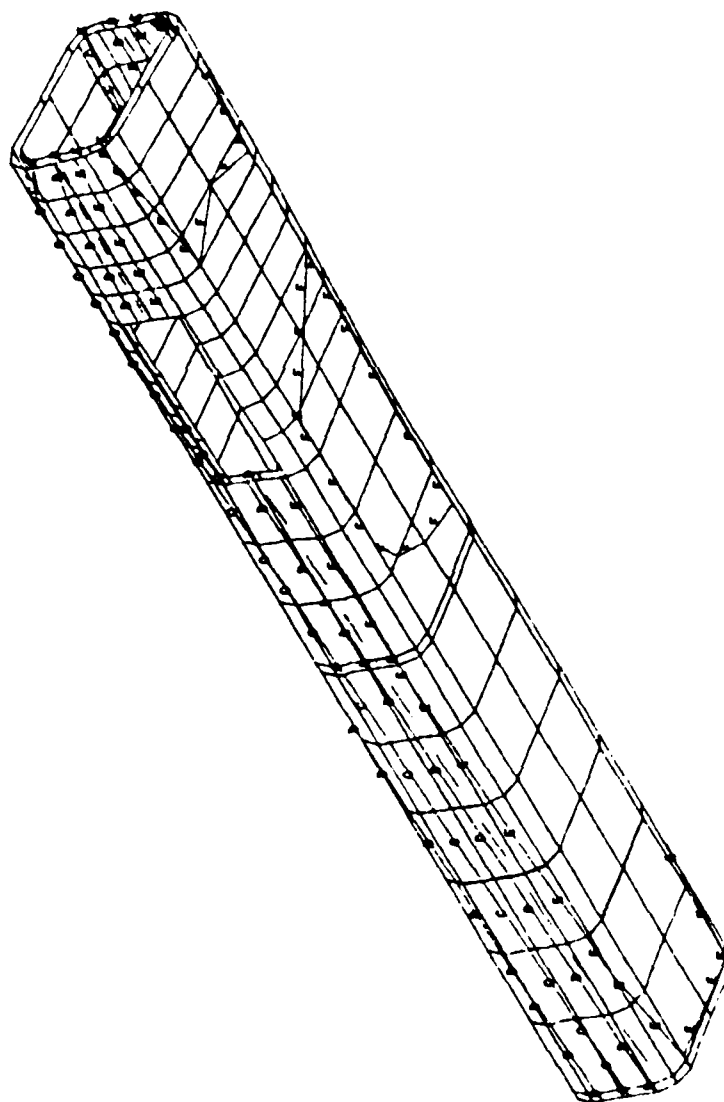
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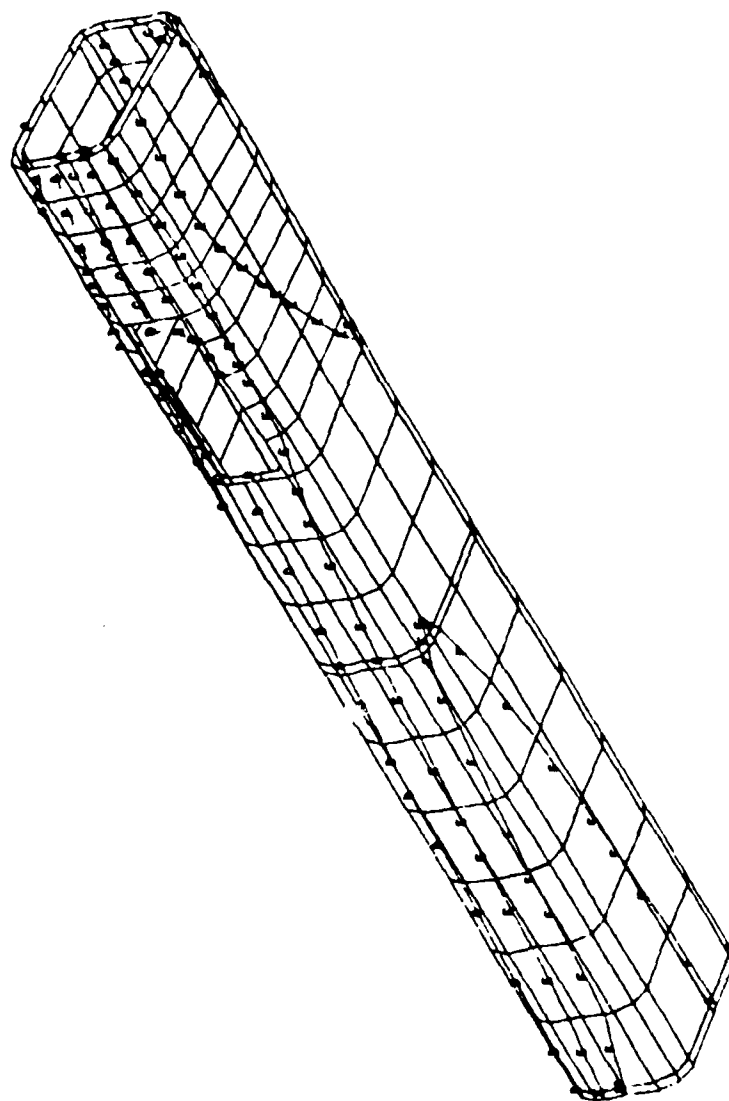
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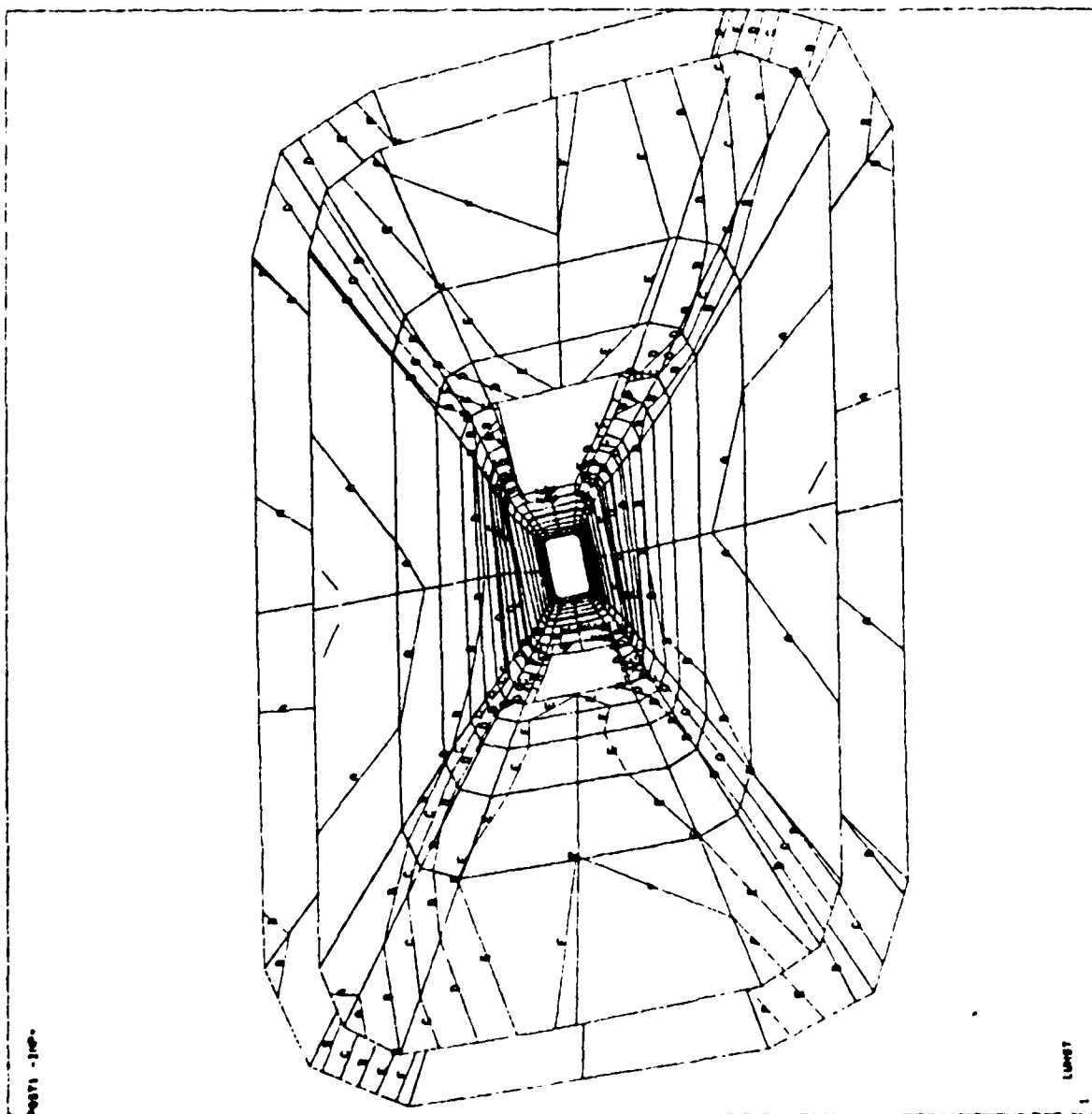
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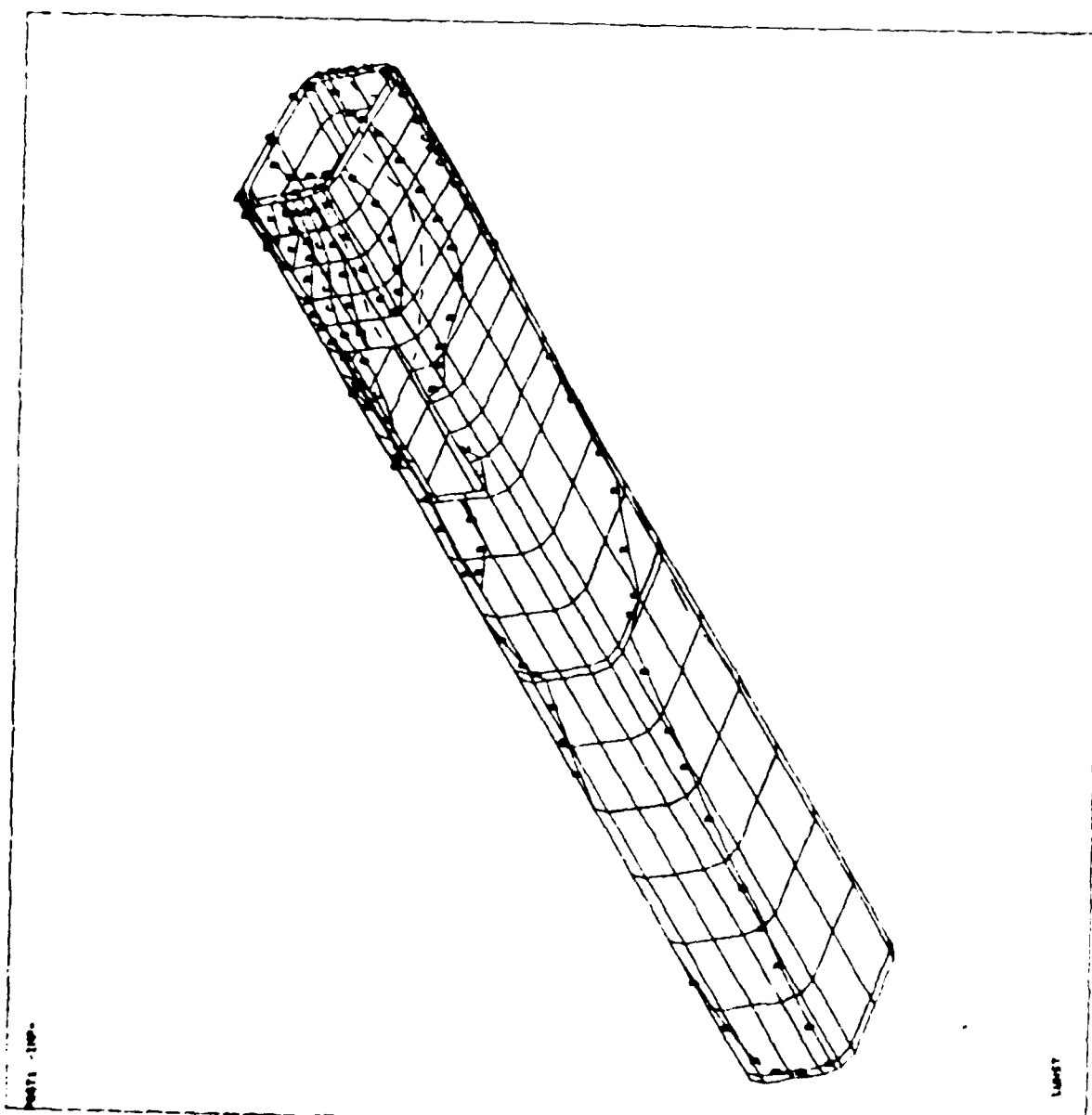
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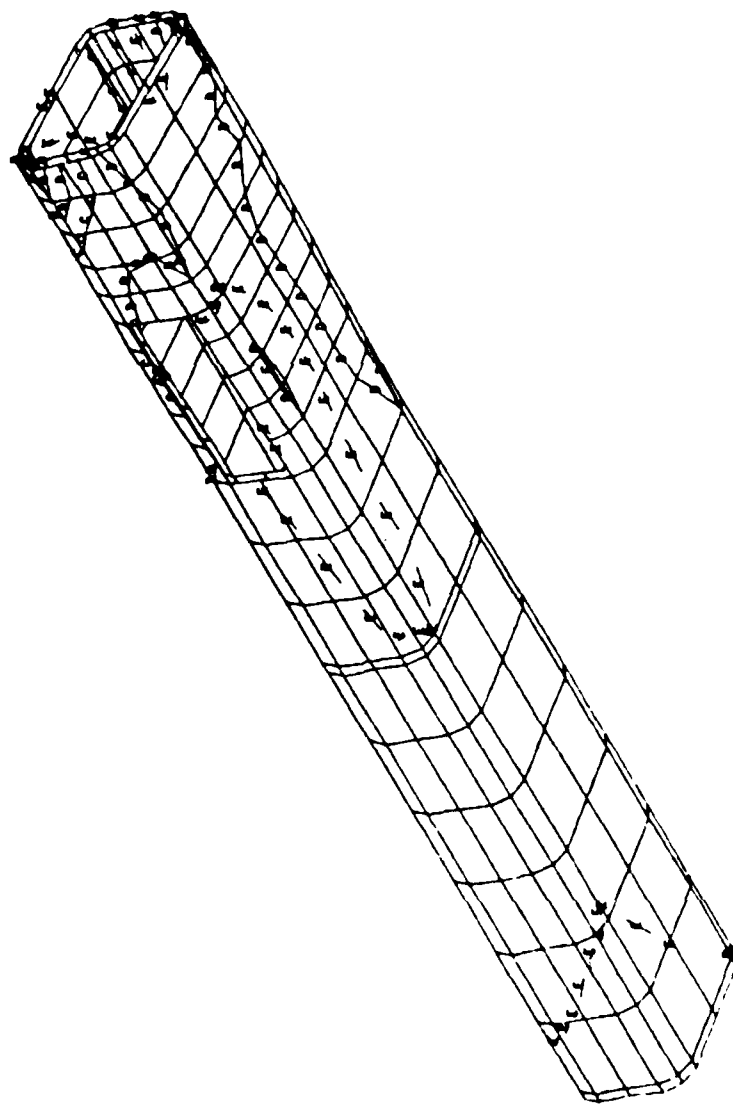
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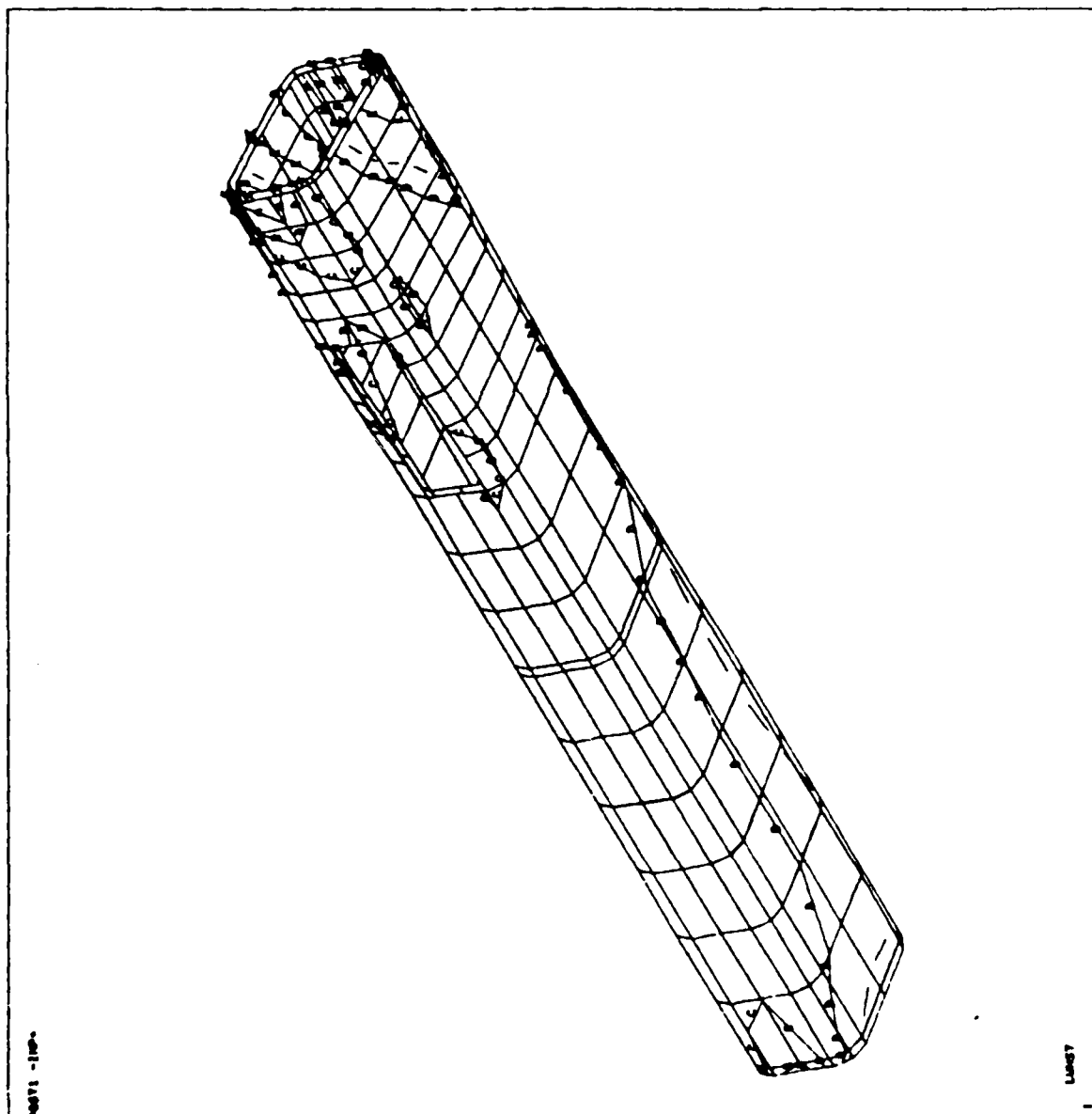
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Luther, 6/1

PRODUCT STRESS PLOT. LABEL: SVI



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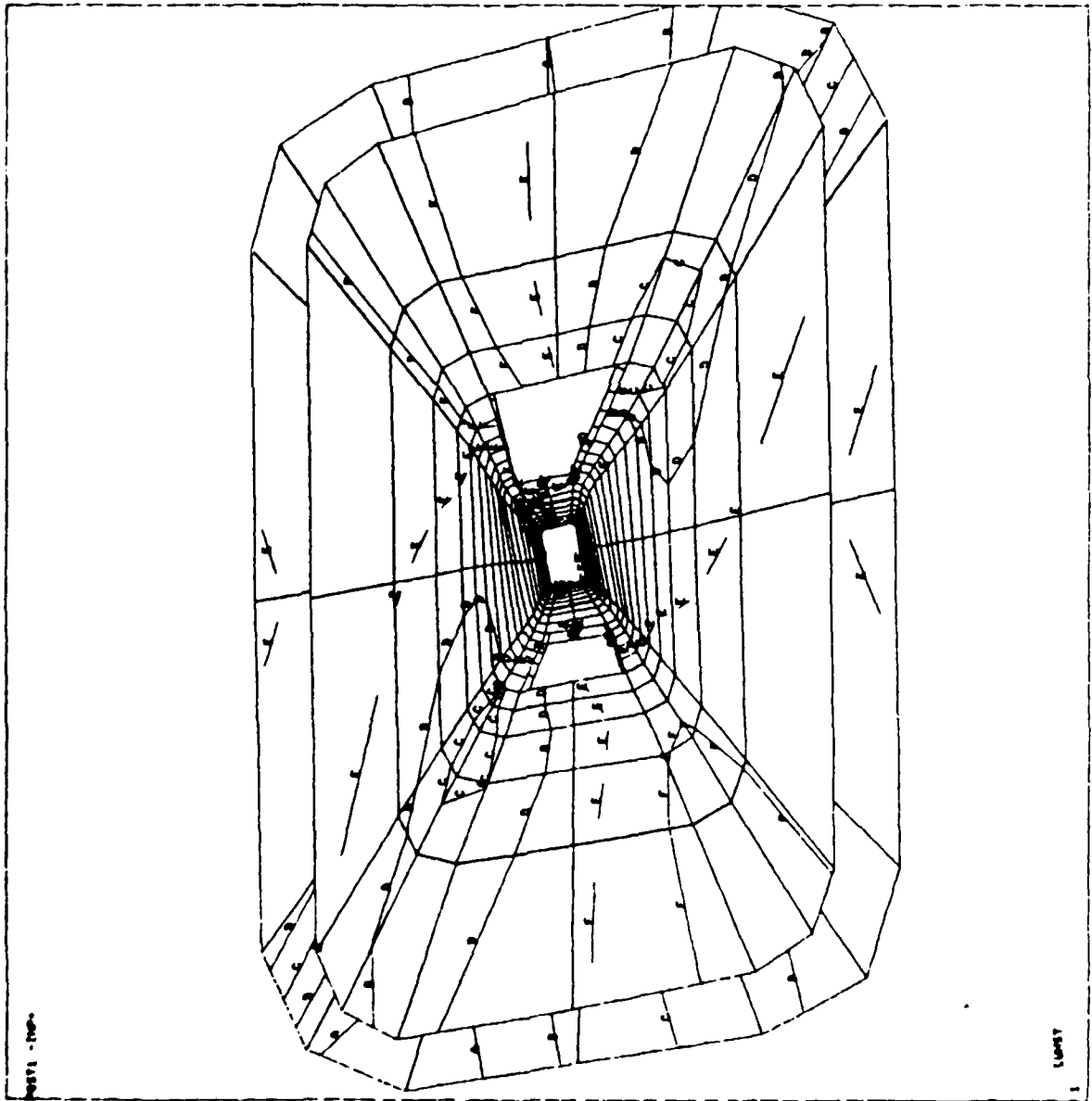
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STEP 38
STEP 39
STEP 40
STEP 41
STEP 42
STEP 43
STEP 44
STEP 45
STEP 46
STEP 47
STEP 48
STEP 49
STEP 50
STEP 51
STEP 52
STEP 53
STEP 54
STEP 55
STEP 56
STEP 57
STEP 58
STEP 59
STEP 60
STEP 61
STEP 62
STEP 63
STEP 64
STEP 65
STEP 66
STEP 67
STEP 68
STEP 69
STEP 70
STEP 71
STEP 72
STEP 73
STEP 74
STEP 75
STEP 76
STEP 77
STEP 78
STEP 79
STEP 80
STEP 81
STEP 82
STEP 83
STEP 84
STEP 85
STEP 86
STEP 87
STEP 88
STEP 89
STEP 90
STEP 91
STEP 92
STEP 93
STEP 94
STEP 95
STEP 96
STEP 97
STEP 98
STEP 99
STEP 100



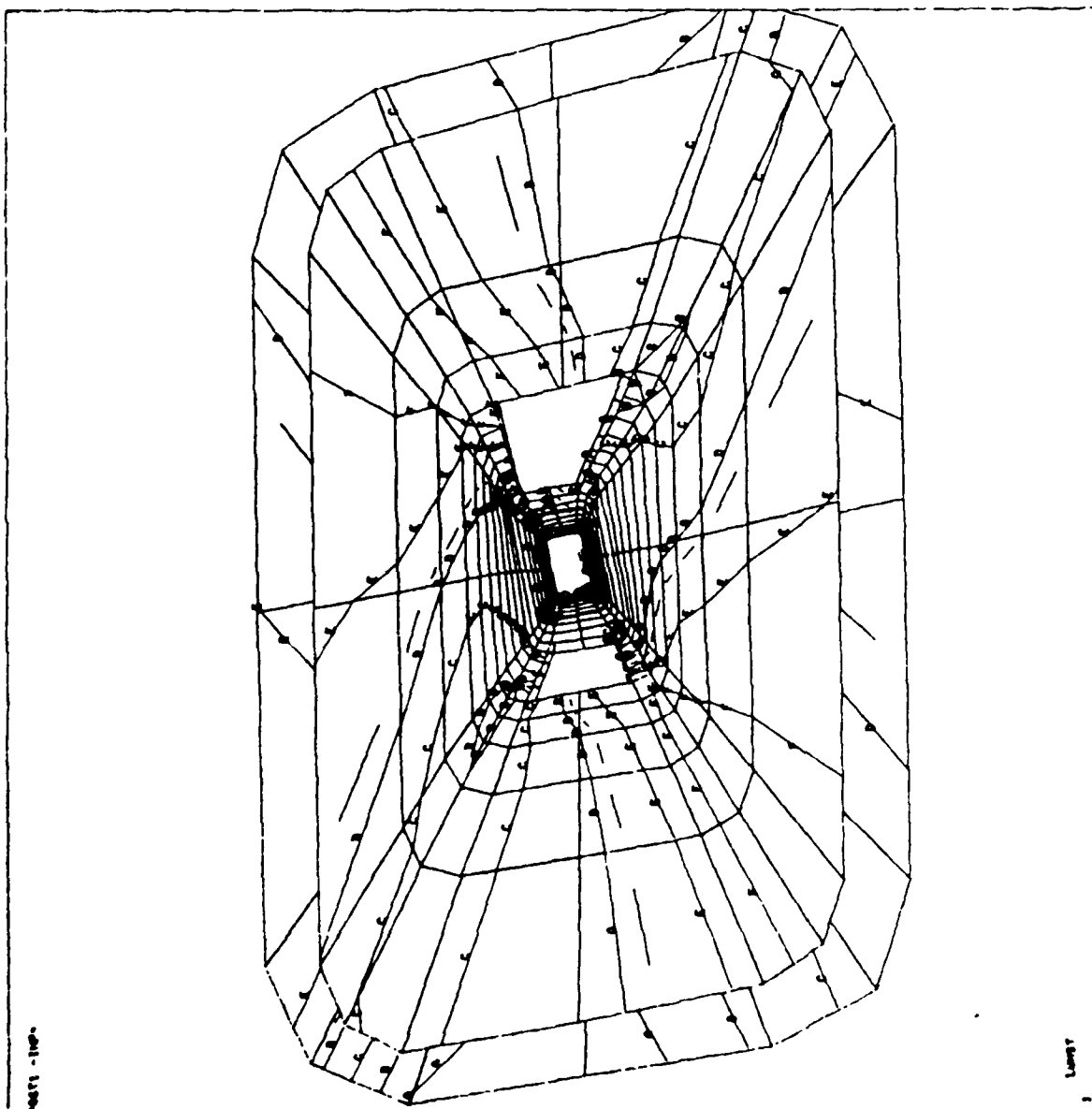
POSTAL SERVICE

1000

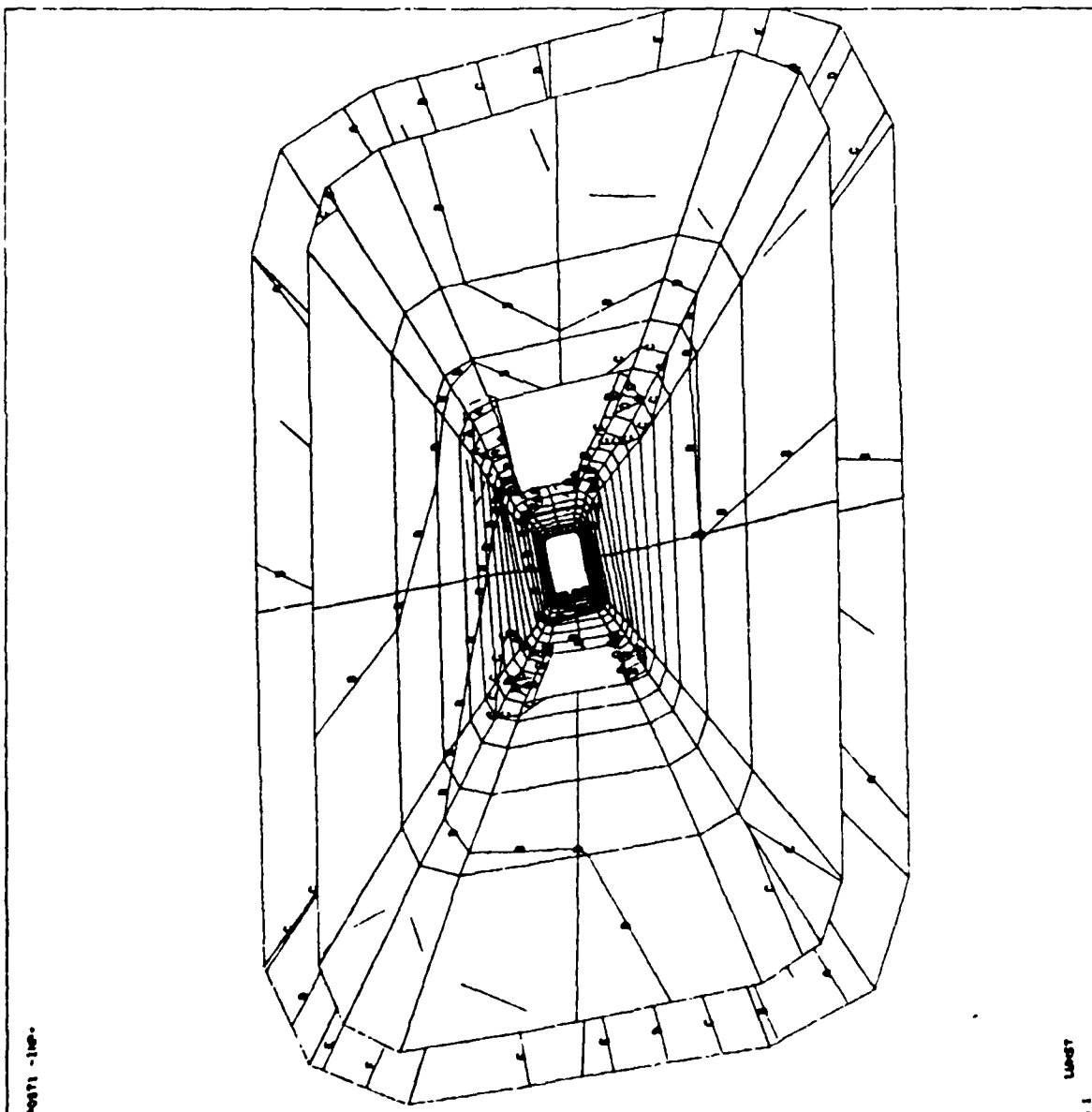
ANSYS 4.20
NOV 84 1006
10:20:20
POST1, STRESS
STEP=1
1720=1
S=1
20=1
0157-120
25=110
CONC=60
MIDTH
MC=36091
PR=01702
A=73411
B=85027
C=30043
D=18210
E=0
F=10304



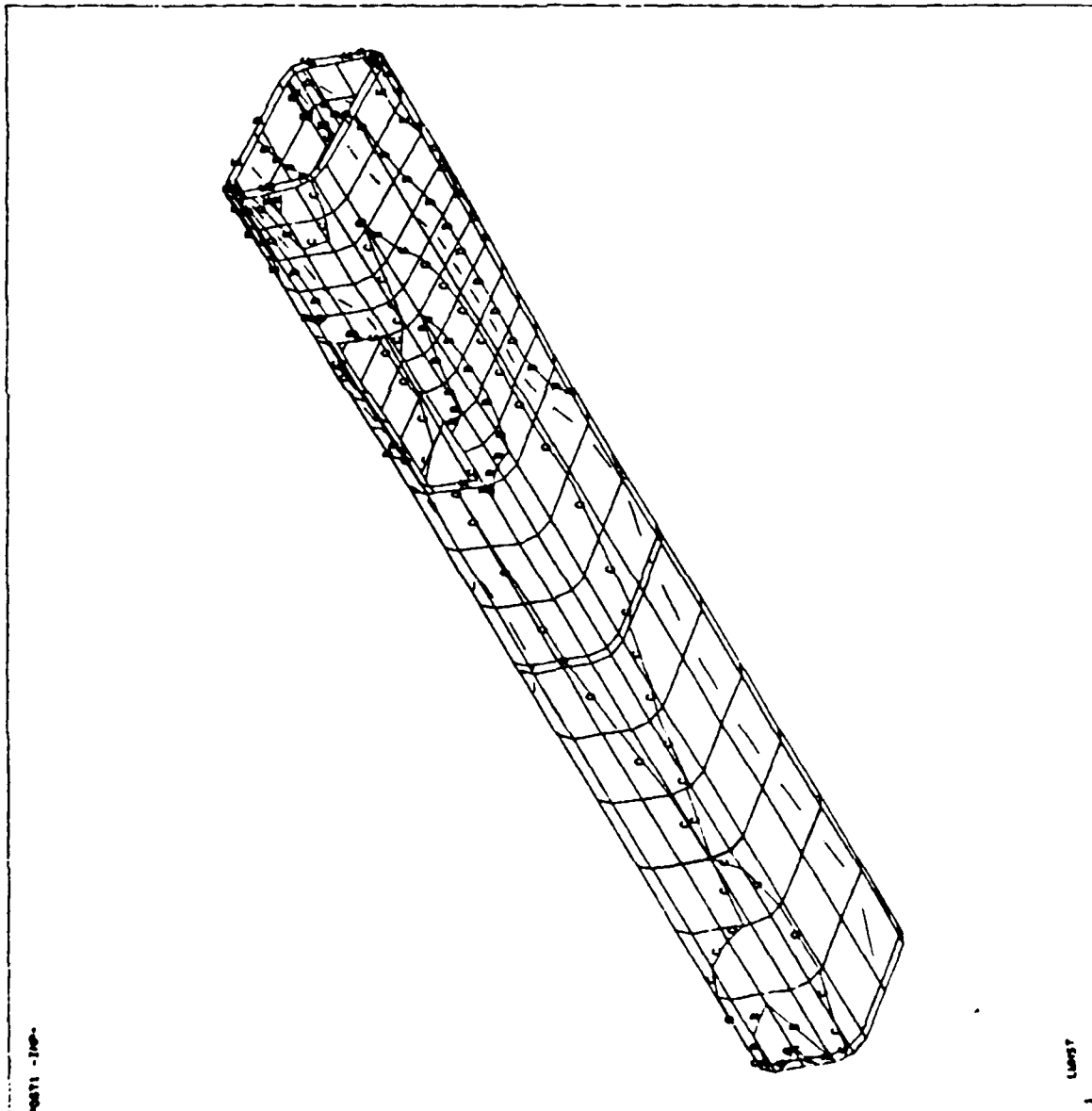
ANALYSIS 4.00
NOV 24 1985
18:42:184
POST1, STRESS
STEP=1
ITER=1
SVI
TOL=1
SIST=128
SP=110
CONV=50
N180CN
PC=8820
NM=-4505
A=-3482
B=-2405
C=-1305
D=-200
E=748
F=1782



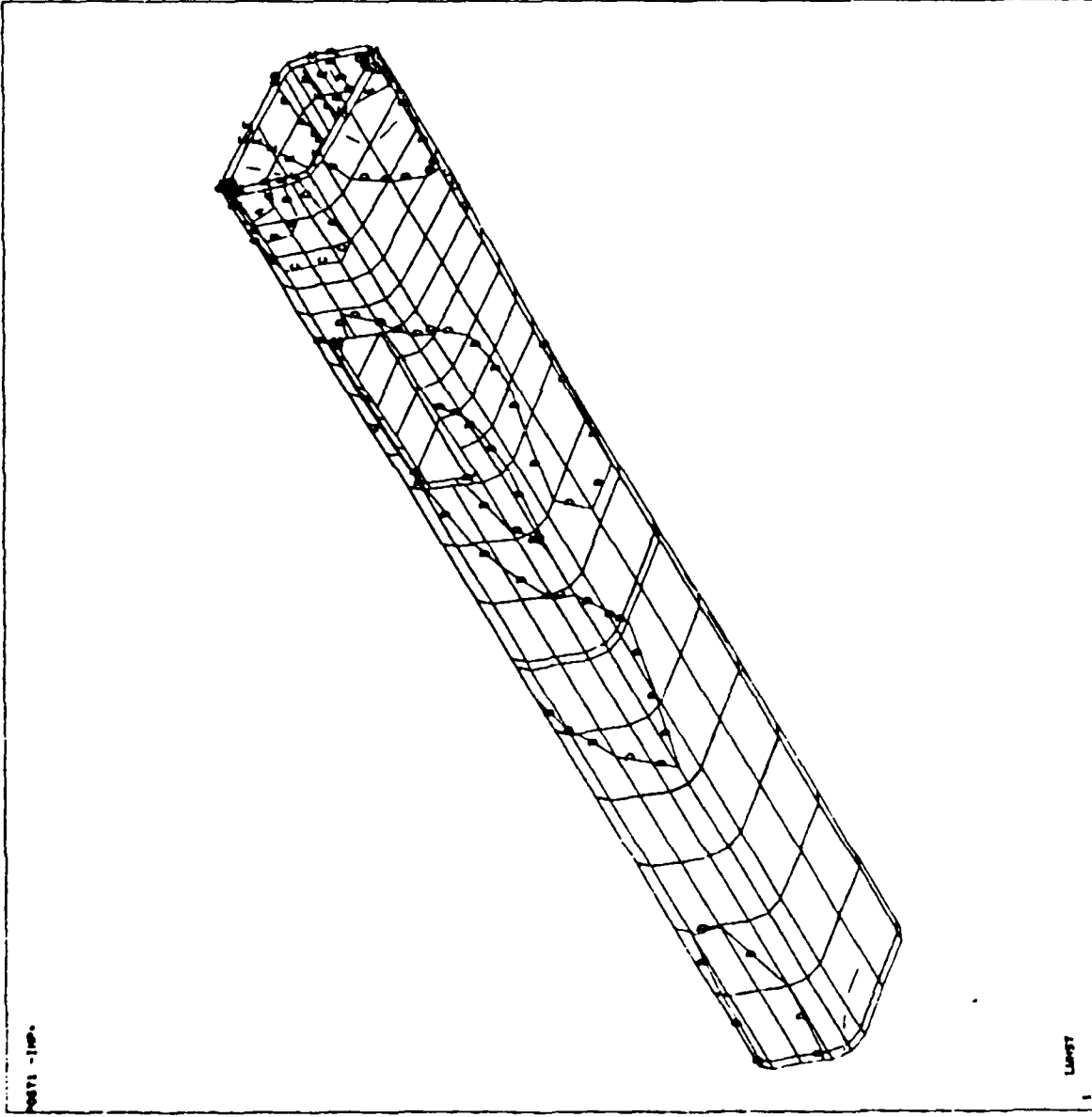
REVISED 4-82
 NOV 24 1986
 18133164
 POST1: STRESS
 STEP=1
 IYER=1
 S41
 20=1
 DIST=132
 27=116
 COME=60
 HIDDEN
 N1=7806
 N1=1931
 A=415
 B=704
 C=2643
 D=3342
 E=4081
 F=5000



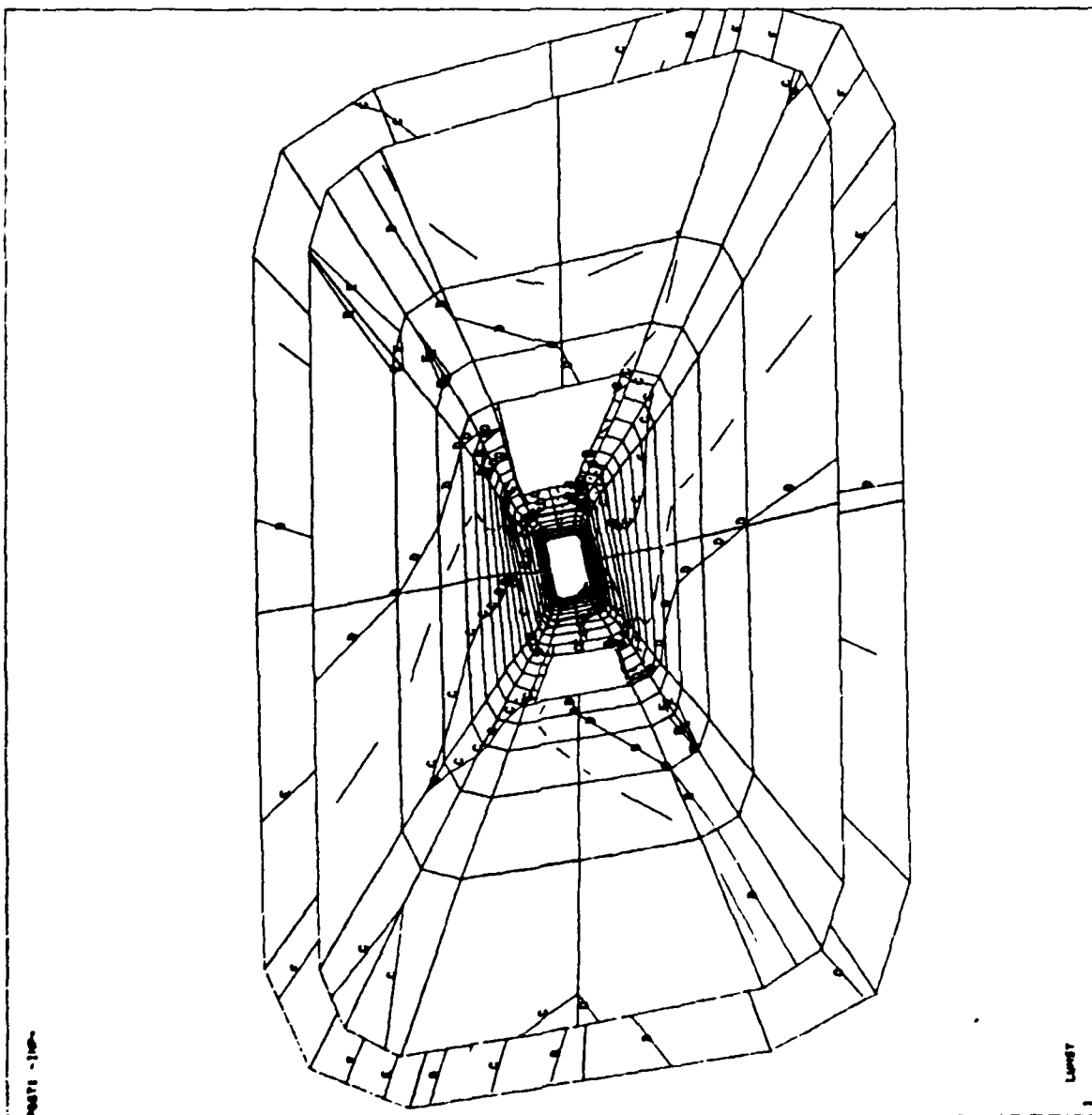
ANALYSIS 4.20
 NO. 24 1900
 17153.61
 POST1 STRESS
 STEP=1
 ITER=1
 SING
 NO=1
 NO=1
 NO=1
 D187-104
 27-116
 M1000
 NO-53568
 NO-55600
 A--6076
 B--24470
 C--8084
 D-8742
 E-22348
 F-27864



ANALYSIS 4.22
NOV 24 1986
10:00:05
POST1, STRESS
STEP=1
ITER=1
SVZ
RV=1
VU=1
ZU=1
DIST=104
ZF=116
HIDEN
NM=2063
NM=-5369
A=-4180
B=-2801
C=-1802
D=-813
E=676
F=1765



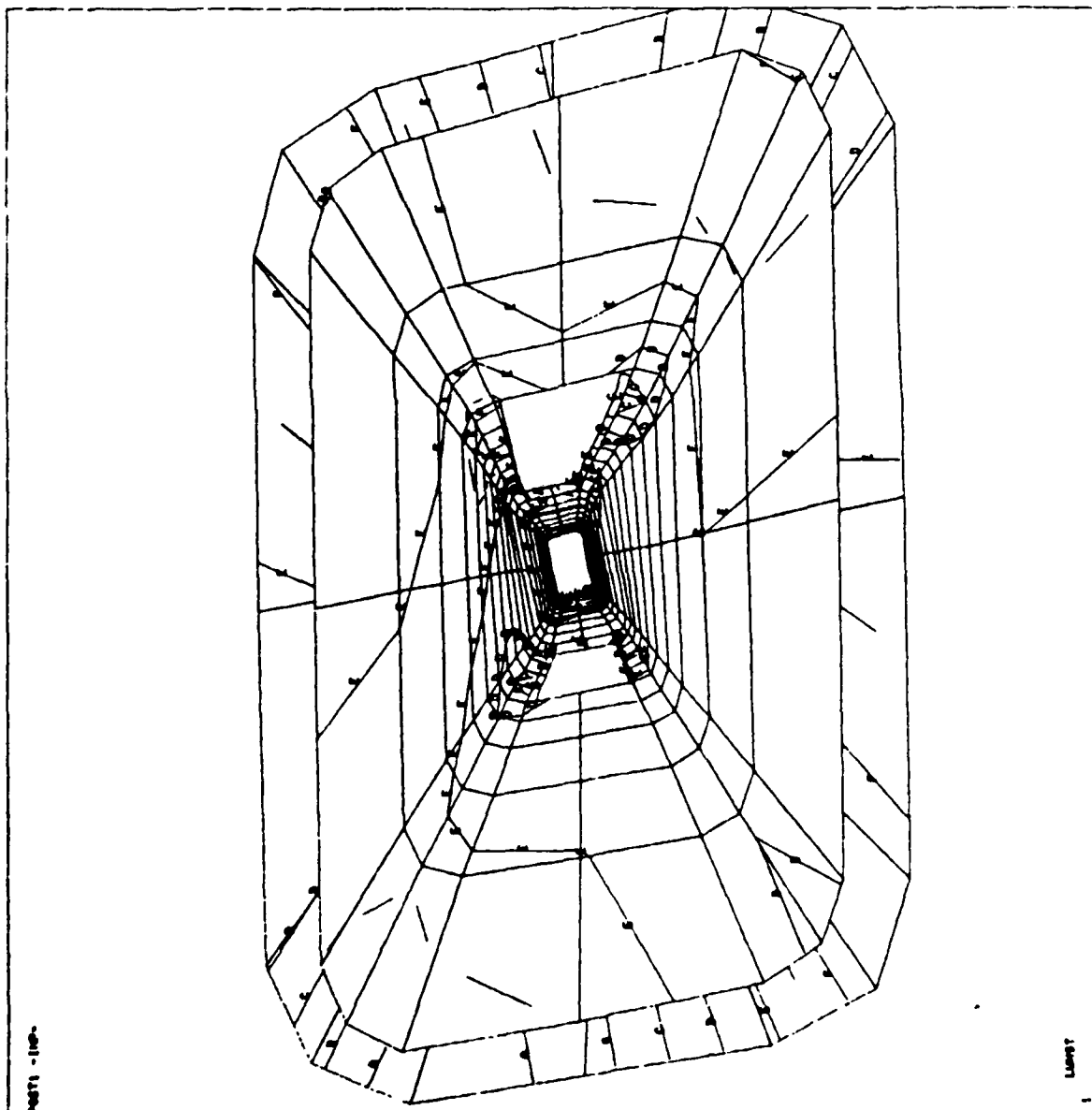
ANALYSIS 4.20
 NOV 24 1965
 10:24:30
 POST1, STRESS
 STEP=1
 ITER=1
 S42
 20=1
 0187=1.32
 27=1.16
 CMC=50
 MIDDEN
 PR=53658
 PW=56680
 A=-40076
 B=-84470
 C=-8084
 D=8742
 E=82348
 F=37964



POST1 -100-

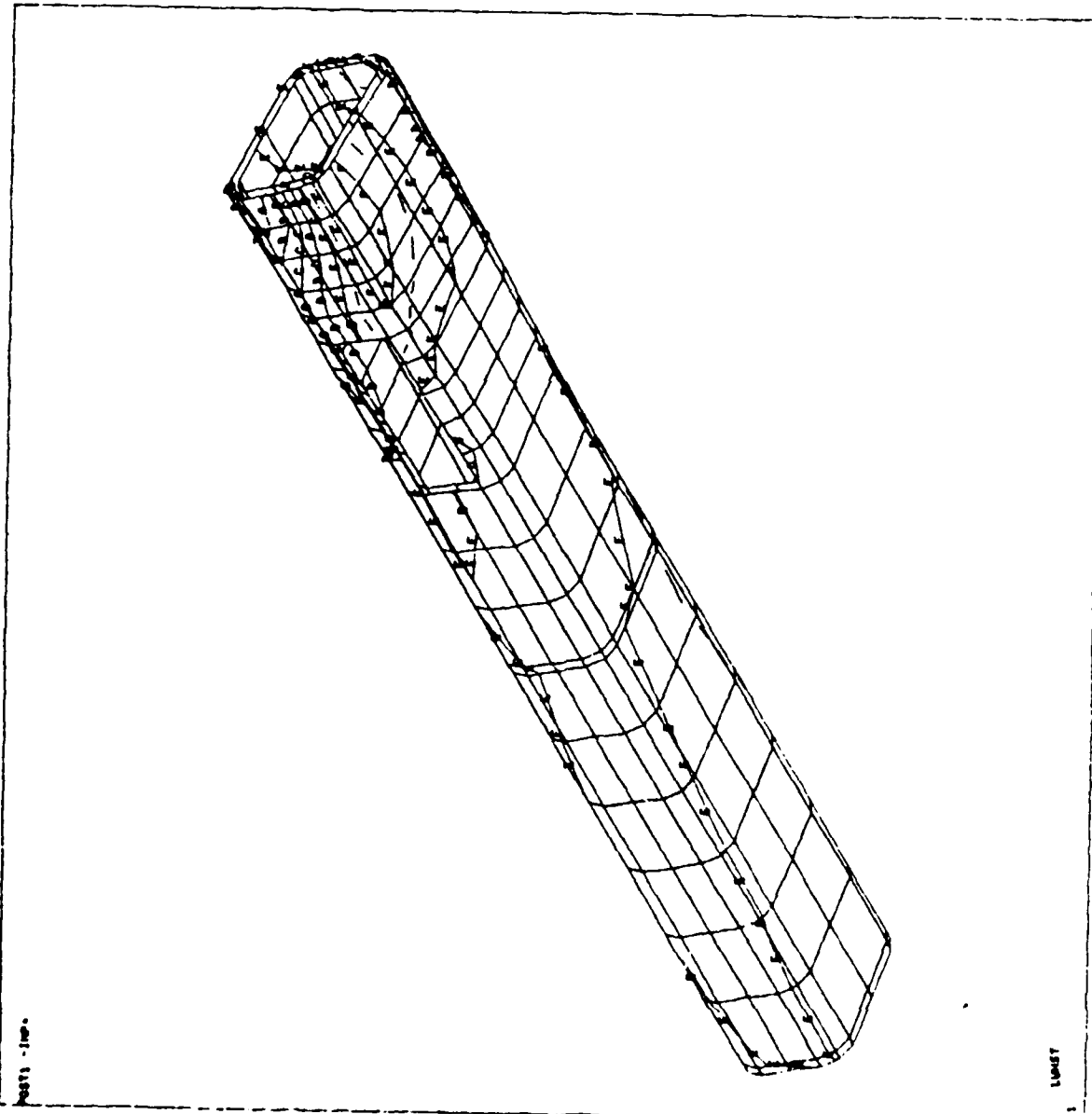
10007

ANALYSIS 4.22
 NOV 24 1995
 18134100
 POST1, STRESS
 STEP=1
 ITER=1
 SHE
 20=1
 9187=132
 27=116
 CORN=50
 MIDBEM
 PR=1926
 PR=7275
 A=5950
 B=4643
 C=3327
 D=2611
 E=486
 F=821



(25)

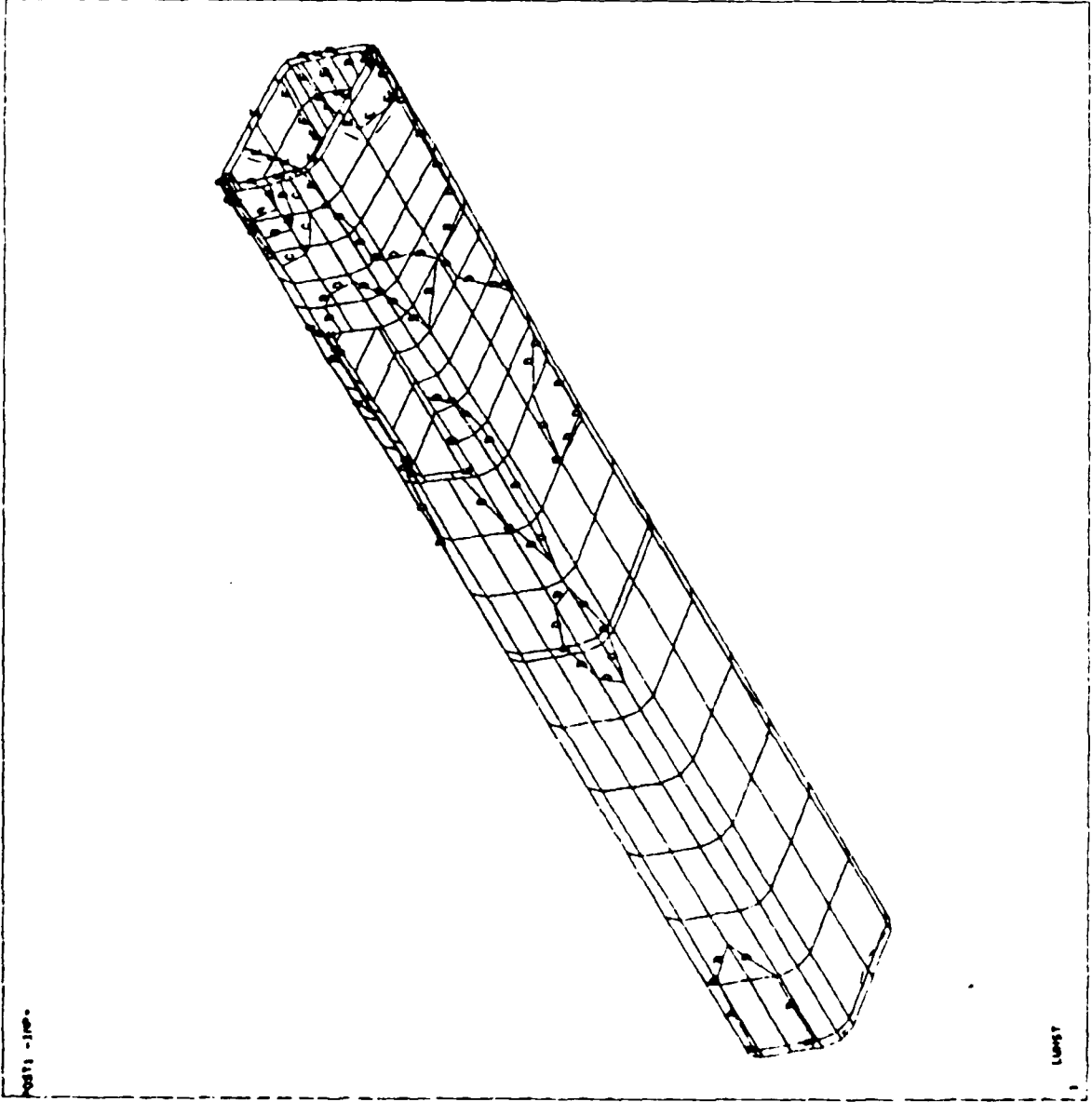
ANALYSIS 4.20
NOV 24 1966
18104120
POST1 STRESS
STEP=1
ITER=1
END
20--1
20--1
20--1
2155-104
25-116
H180W
PC-1930
PW-7276
A--5069
B--4643
C--3347
D--2011
E--0195
F--021



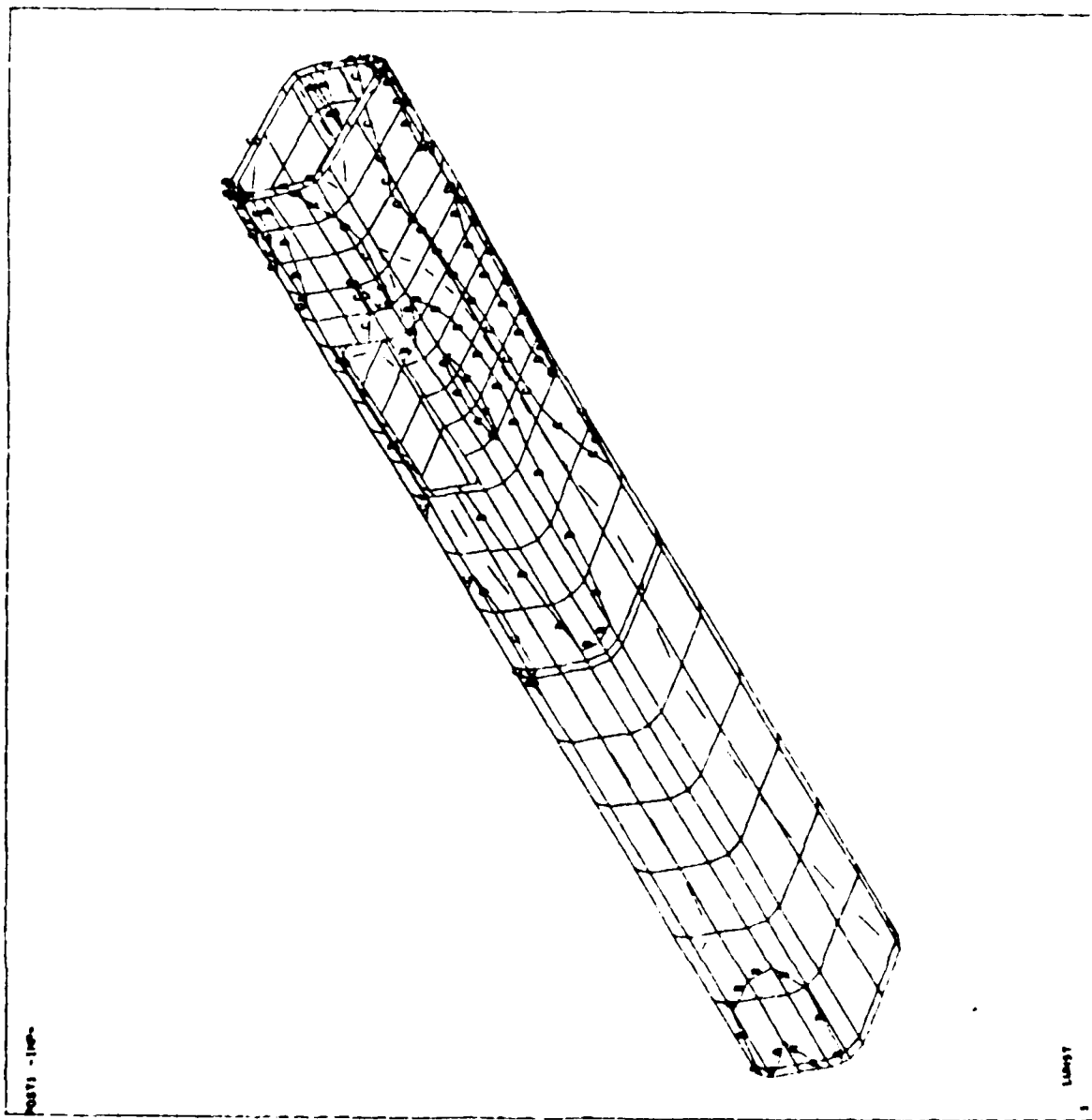
1

100-100000

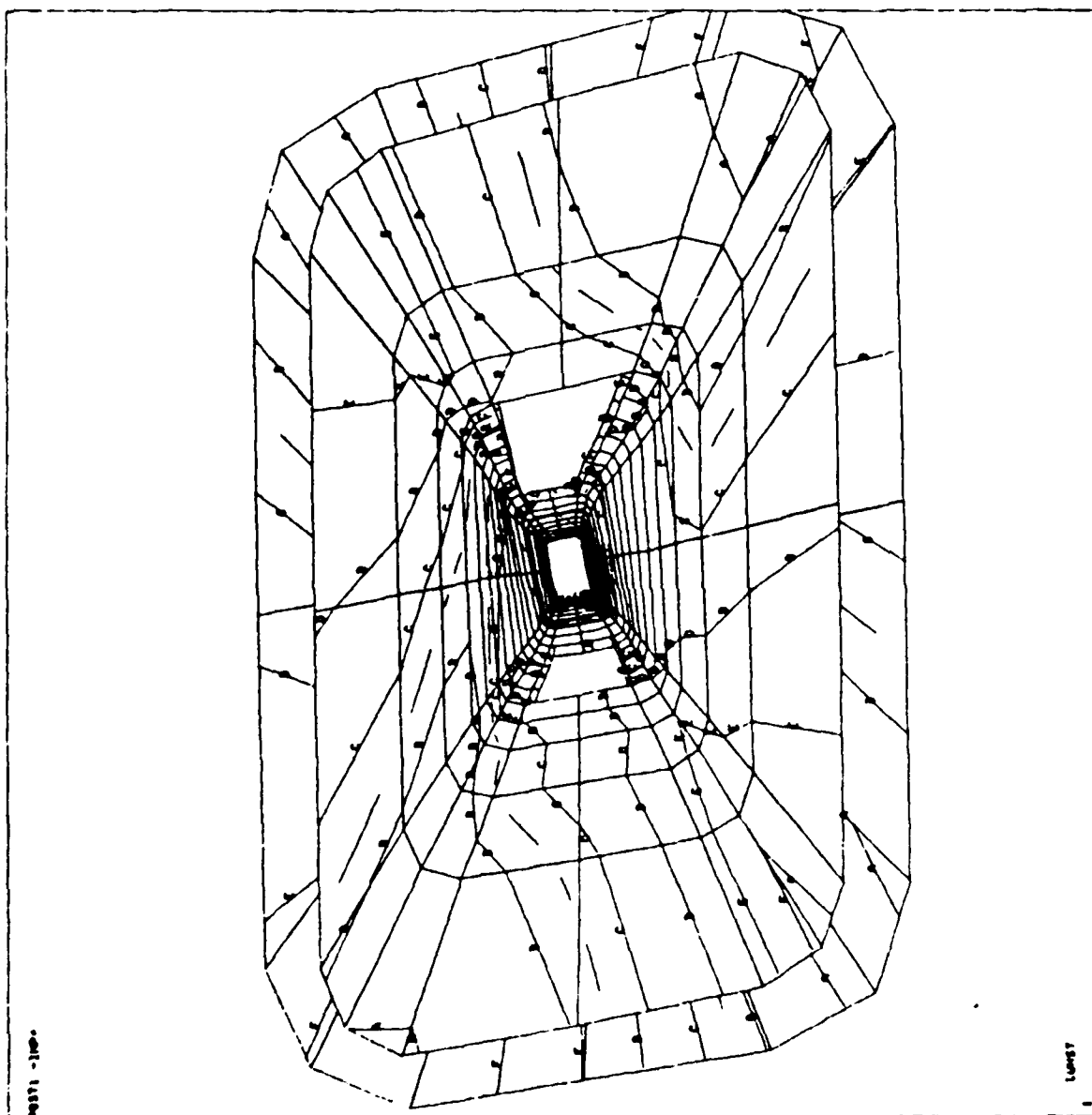
ANALYSIS 4.20
NOV 24 1986
18:06:10
POST1, STRESS
STEP=1
ITER=1
SVZ
Z0=1
Z1=1
Z2=1
DIST=104
Z=116
HIDDEN
RU=8768
RM=8244
A=8646
B=3766
C=2403
D=1142
E=169
F=146



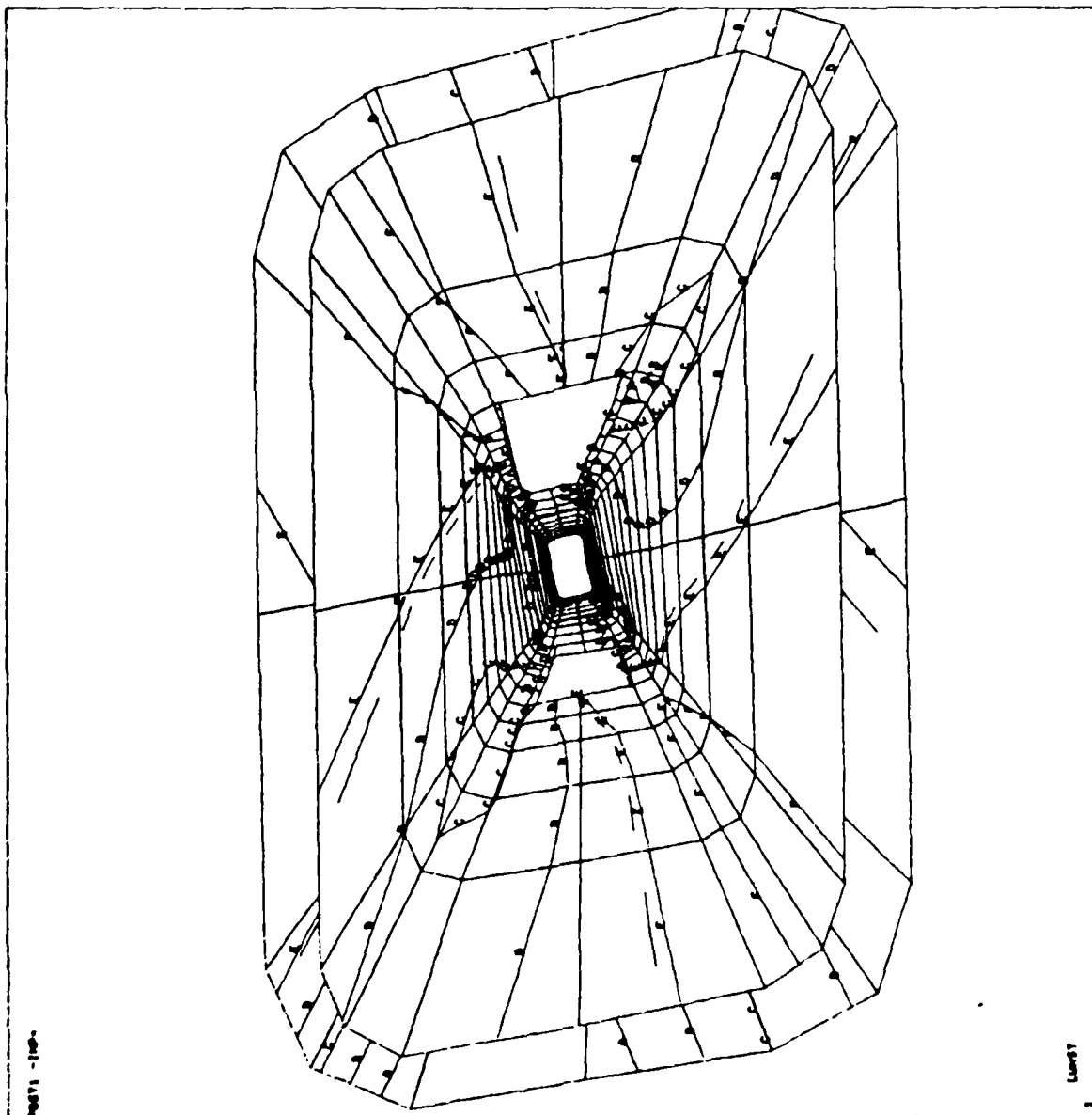
AMPYS 4.20
 NOV 24 1986
 18:07:00
 POST1,SYNCS0
 STEP=1
 TIME=1
 04)
 RU=1
 VU=1
 ZU=1
 0157-104
 27-115
 MIDDLE
 RU=0.295
 VU=0.275
 AU=1.017
 B=540
 C=491
 D=1260
 E=2310
 F=3270



00375 4.20
 NOV 24 1968
 18780137
 POST 1 0700 65
 STEP 1
 TCR 1
 SIX
 20-1
 8187-130
 27-116
 COMS-50
 M18047
 PU-65510
 PW-25461
 A-21030
 B-5613
 C-7818
 D-82237
 E-30662
 F-51097



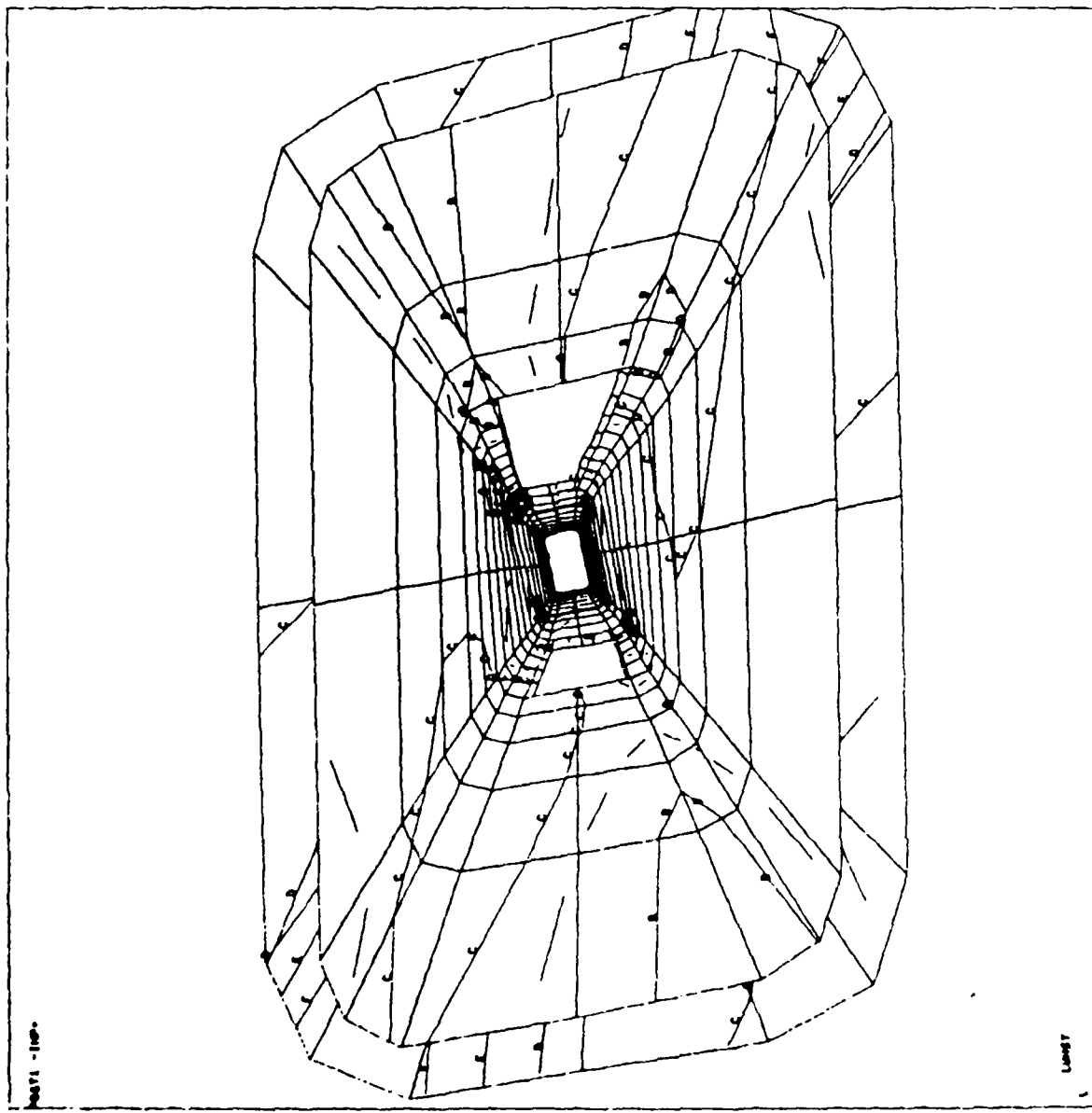
00100 4.00
 NOV 24 1965
 10-31-64
 00071 070000
 5100-1
 1100-1
 912
 20-1
 0107-132
 20-115
 CODE-60
 M1000M
 RM-2750
 RM-4344
 A-8045
 B-3744
 C-2443
 D-1142
 E-110
 F-1440



00071-1000

100071

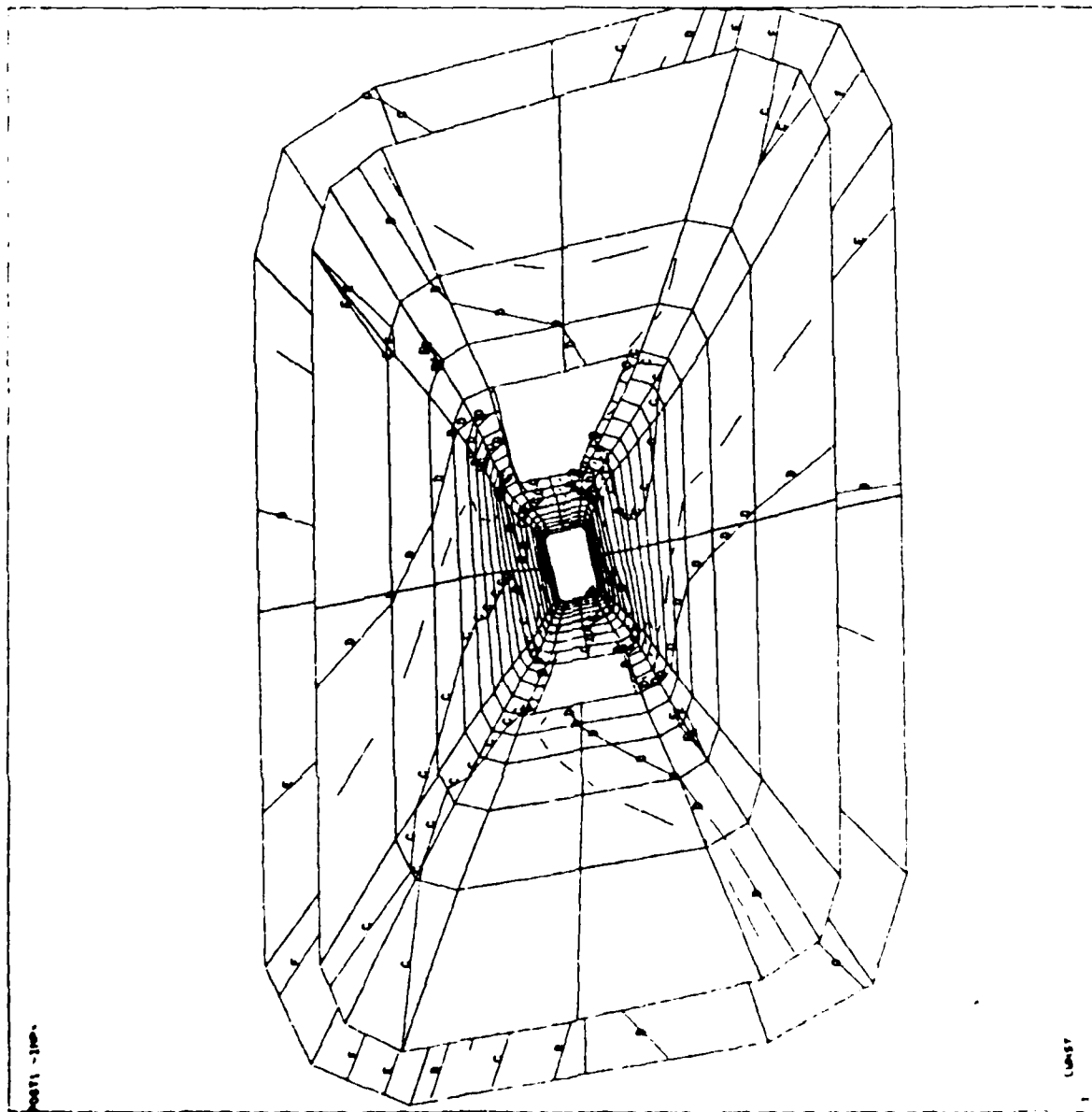
NOV 84 1984
18:30:26
POST1, STRESS
STEP=1
ITER=1
SALZ
20=1
0157-132
20=116
CONC=60
41802H
P0=6876
P0=8476
A=1517
B=1560
C=401
D=1360
E=2319
F=3278



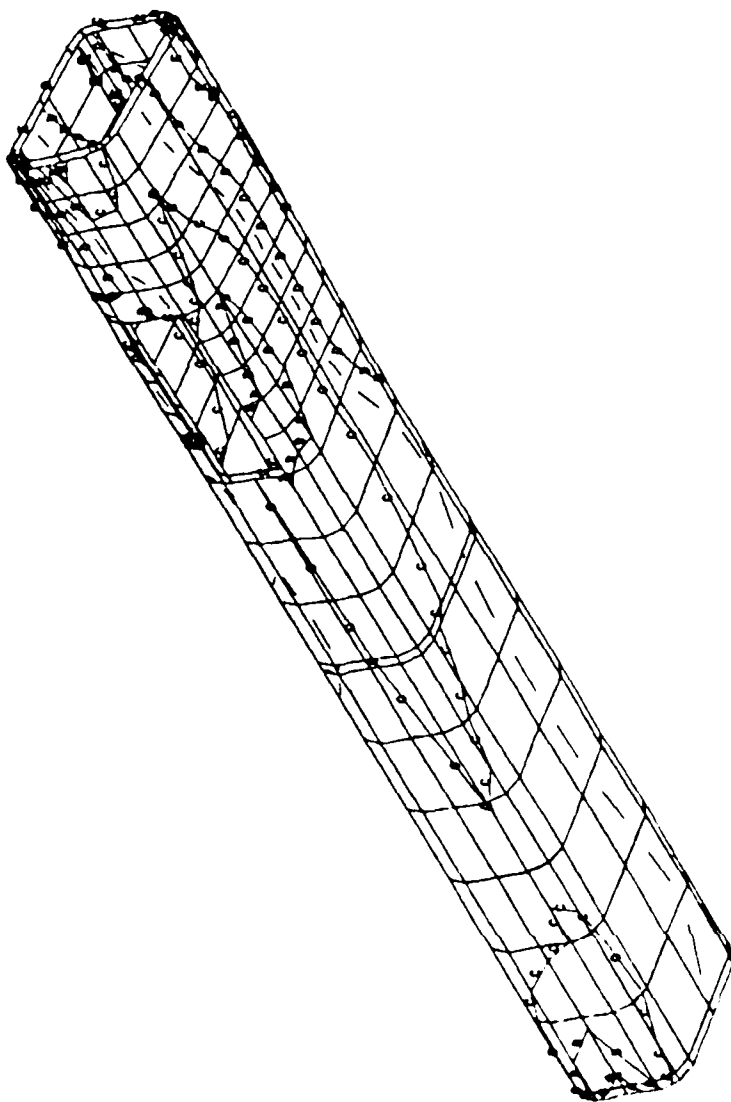
```

STEP1  1.20
MOD 25 1804
9/21/79
POST1  STRESS
STEP=1
ITER=1
$K
20=1
D187=1.38
27=1.16
COMP=46
HIDDEN
PR=55813
PR=55443
A=48188
B=24721
C=8654
D=8213
E=21880
F=37167

```



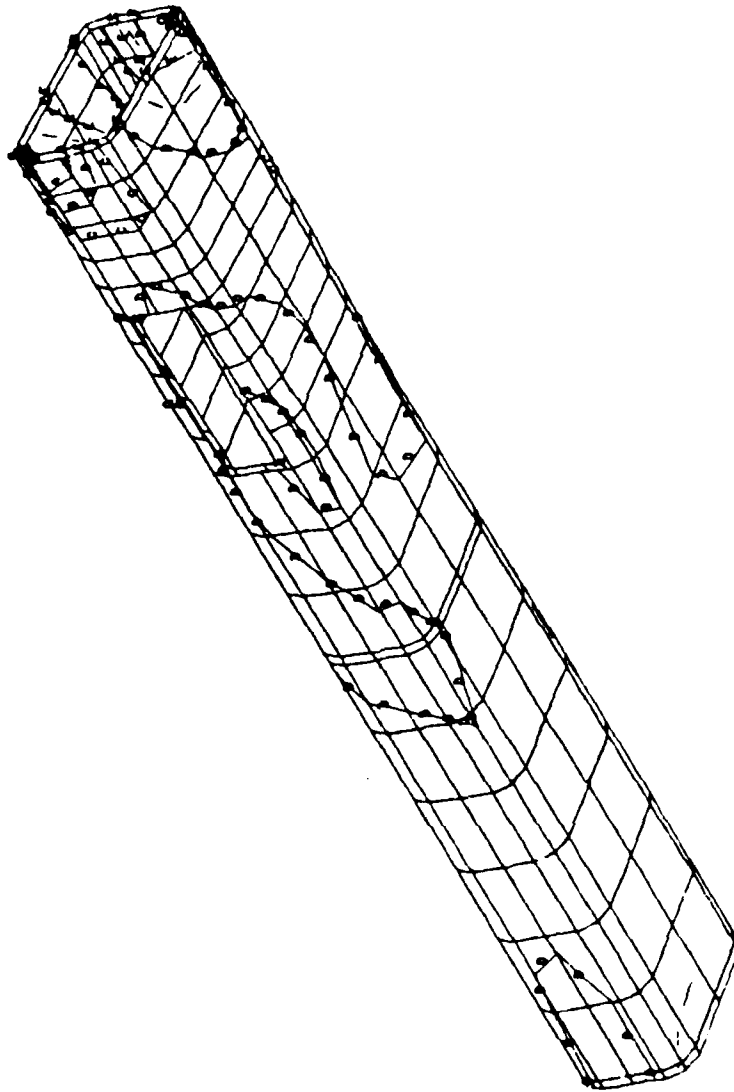
MOD/ 85 1006
 B-47104
 POS 71 87065
 STEP-1
 ITER-1
 S14
 NU--1
 VU--1
 ZU--1
 DIST-104
 ZF-116
 MIDSEN
 PR-63613
 PR--8663
 A--40188
 B--8721
 C--8254
 D-6213
 E-81006
 F-37147



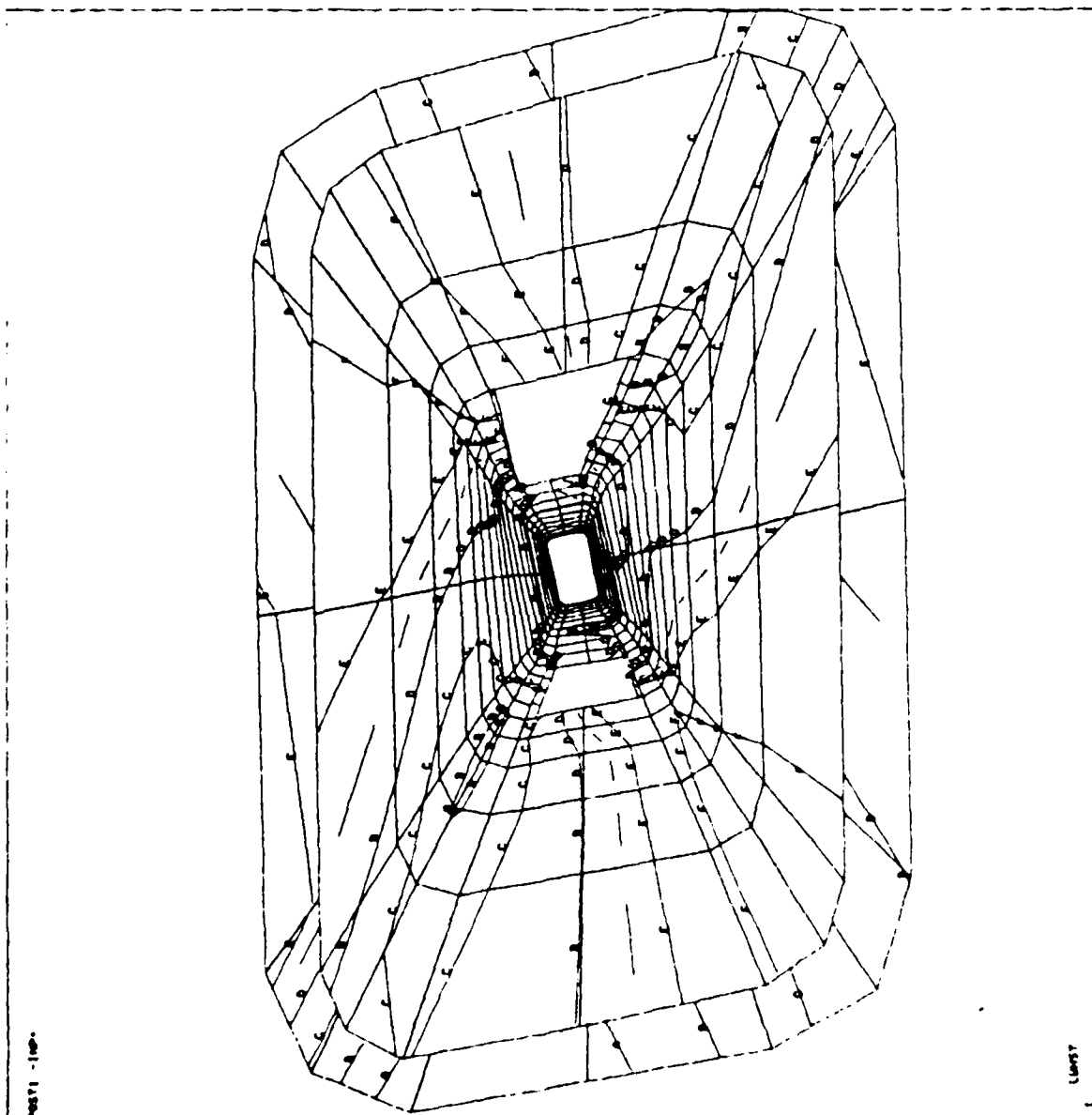
POST1 -100-

10057

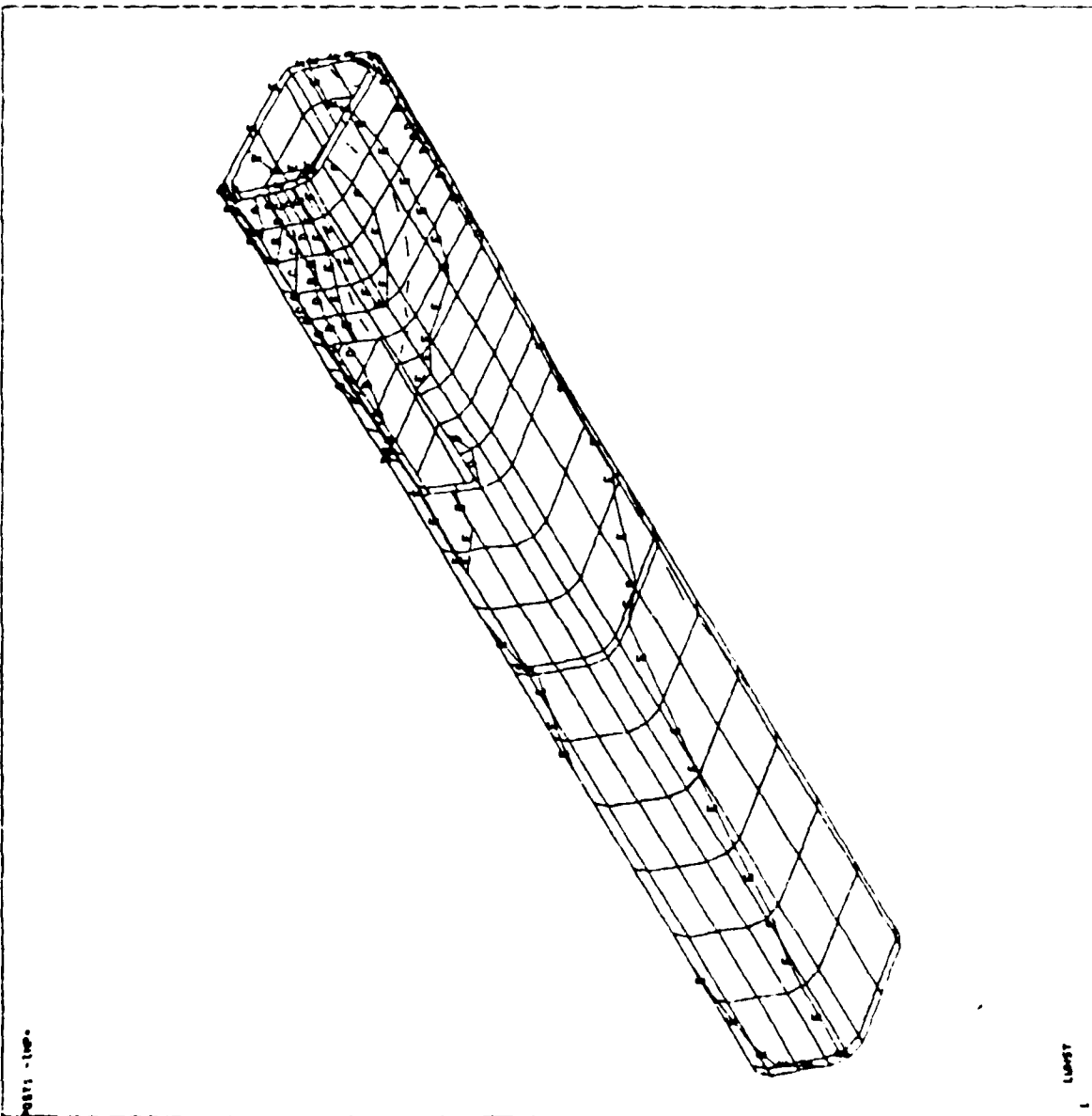
408145 4.20
 NOV 25 1966
 14100.48
 POSIT. STRESS
 STEP-1
 TYP-1
 SV4
 KU-1
 KU-1
 VU-1
 VU-1
 20-1
 2107-104
 2F-116
 M1204
 M1204
 M1-515
 M1-4236
 B-3043
 C-11089
 B-686
 E-487
 F-1690



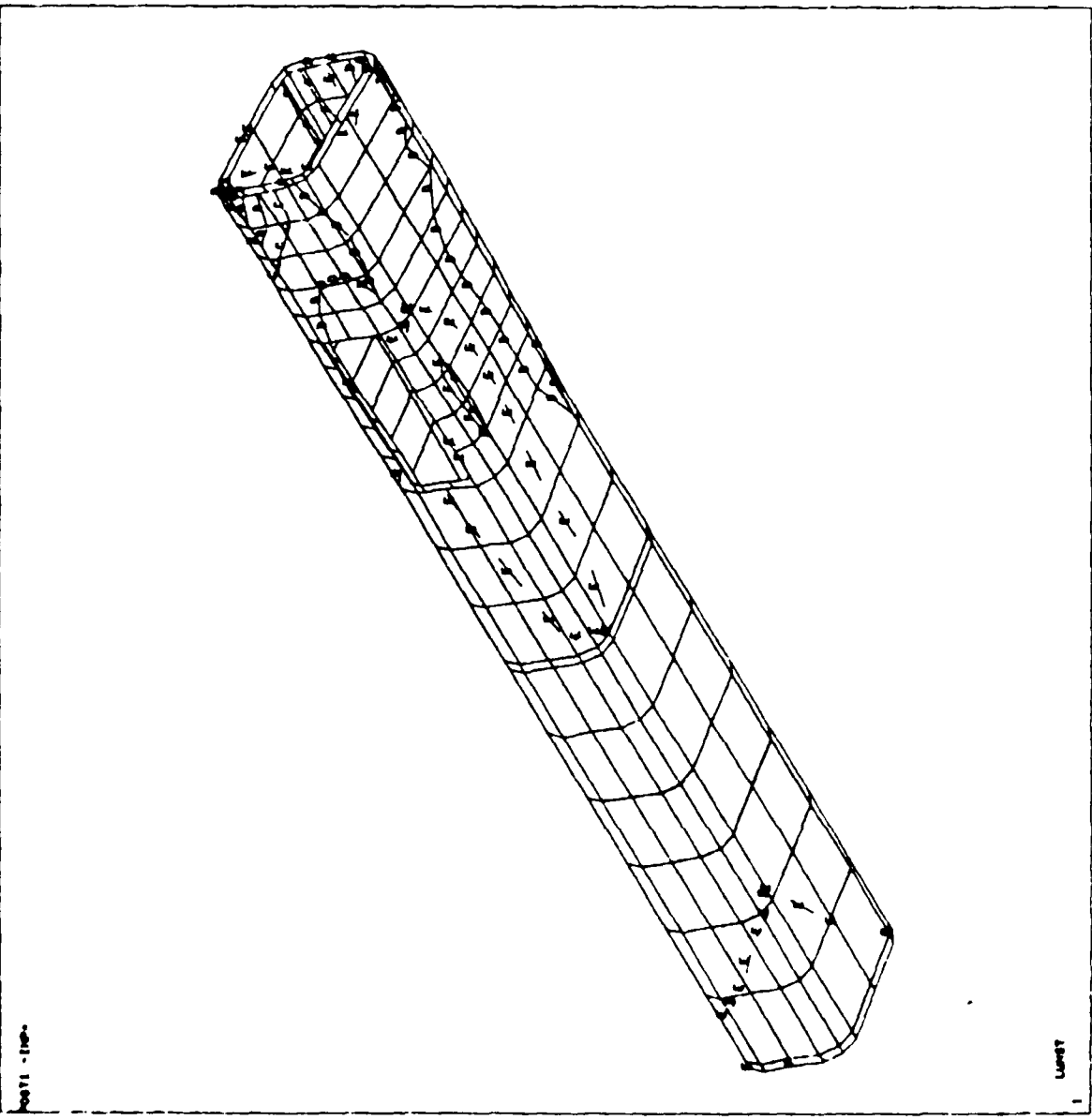
ANALYSIS 0.20
NOV 25 1966
B12C-118
POST1, STRESS
STEP=1
ITER=1
SV4
ZU=1
DIST=125
ZF=116
CODE=46
HIDDEN
R1=2260
R2=5415
A1=4226
B1=2052
C1=1060
D1=606
E=497
F=1800



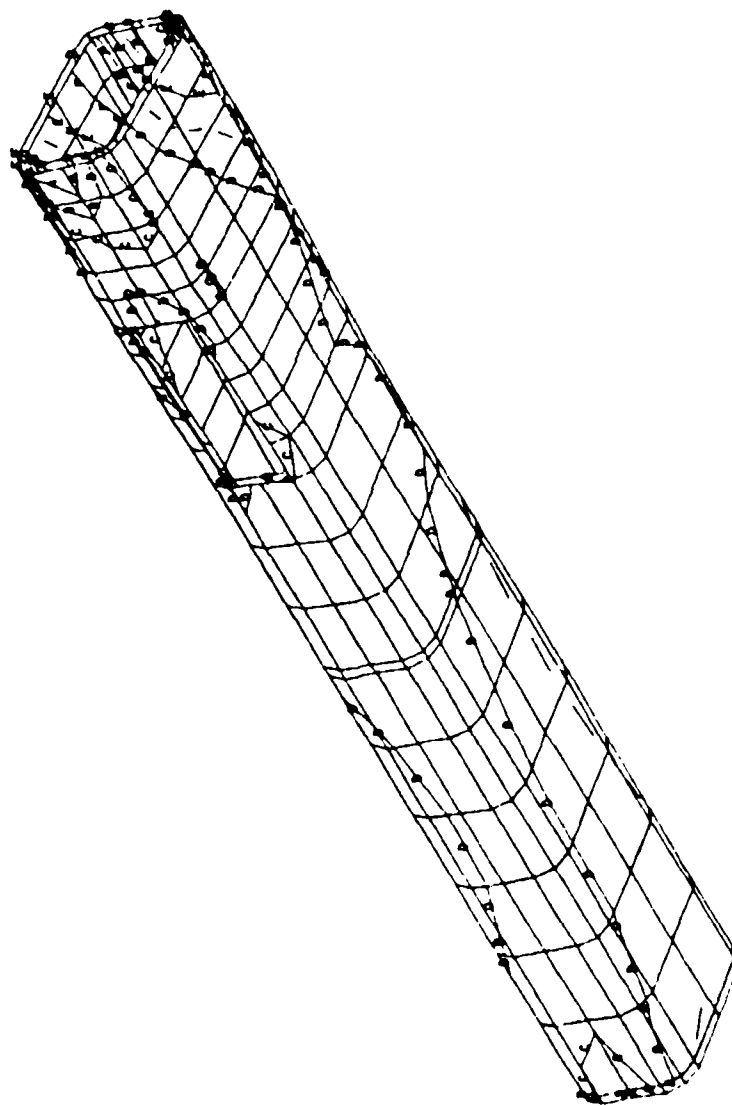
ANALYSIS 4.20
NOV 25 1966
S-07110
POST1 STRESS
STEP=1
ITER=1
S=4
R=1
V=1
Z=1
D107-104
Z=116
M1000N
W=1940
W=7223
A=6023
B=4011
C=3200
D=1007
E=676
F=637



00014 4.20
 NOV 25 1995
 8:42:25
 POS: 070E55
 STEP: 1
 ITER: 1
 SLS
 MU: 1
 VU: 1
 ZU: 1
 DIST: 104
 ZF: 116
 MID: 604
 RW: 34732
 RW: 82236
 A: 74099
 B: 95360
 C: 37821
 D: 19602
 E: 1543
 F: 18594

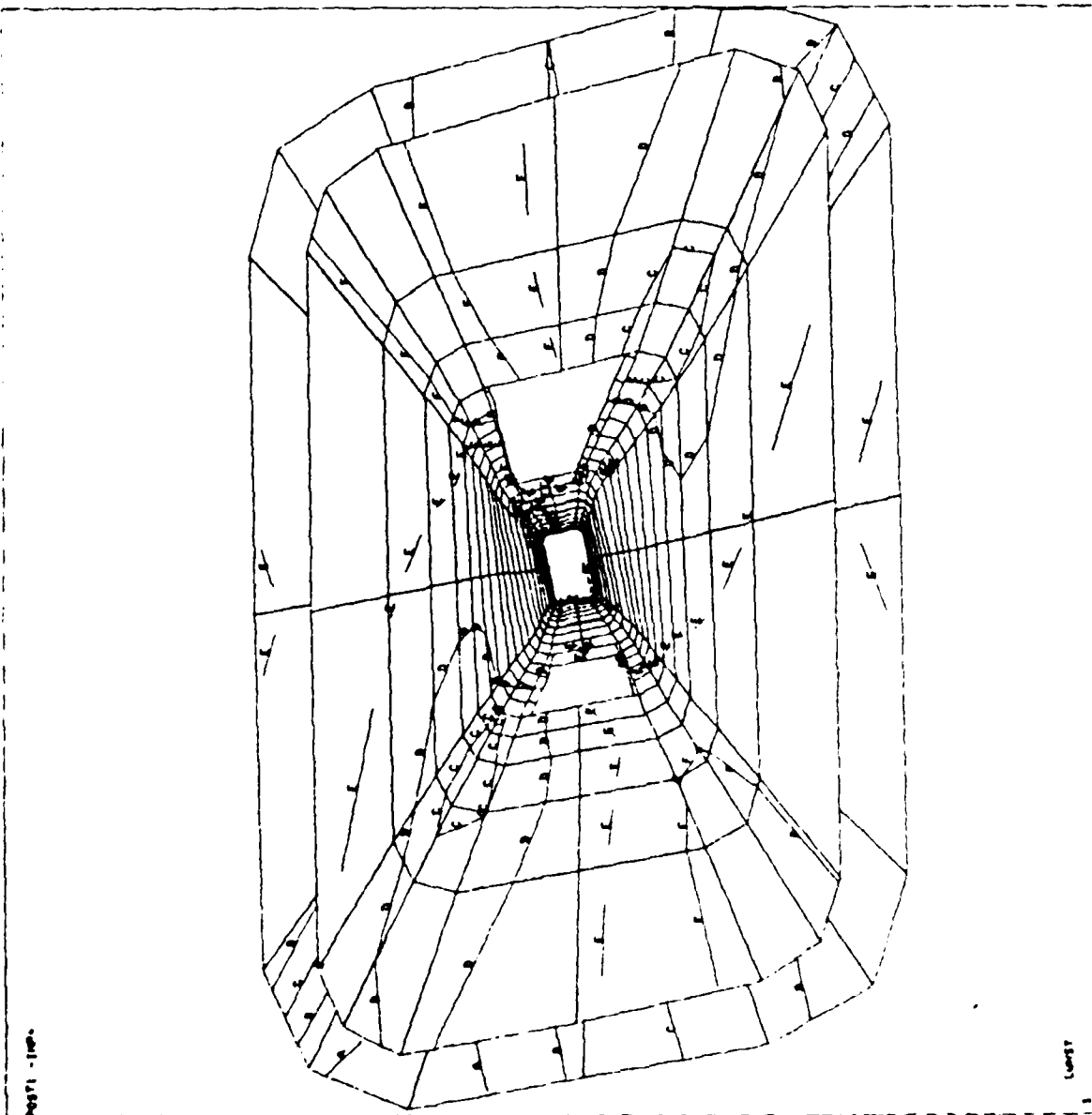


11

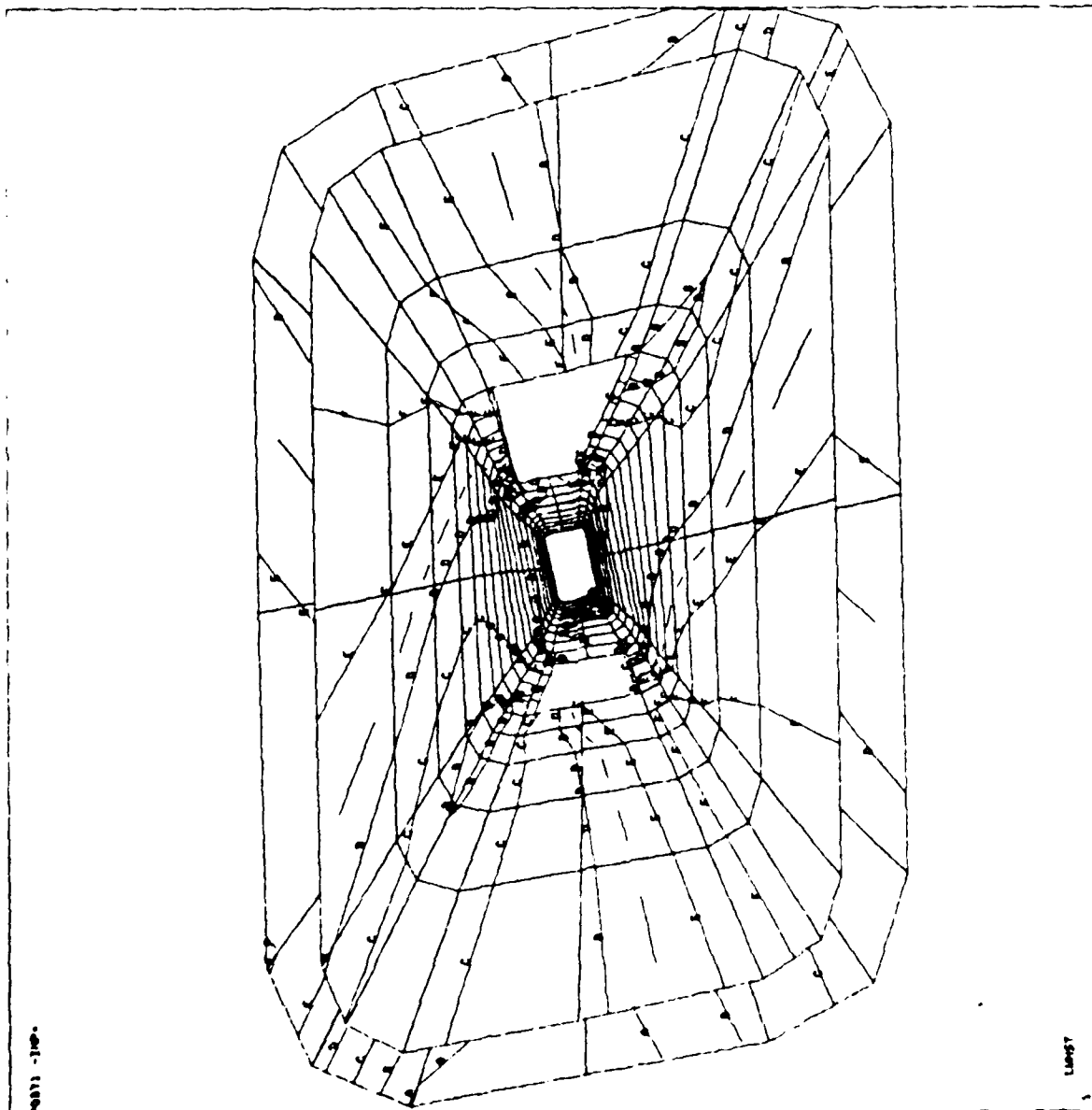


1947

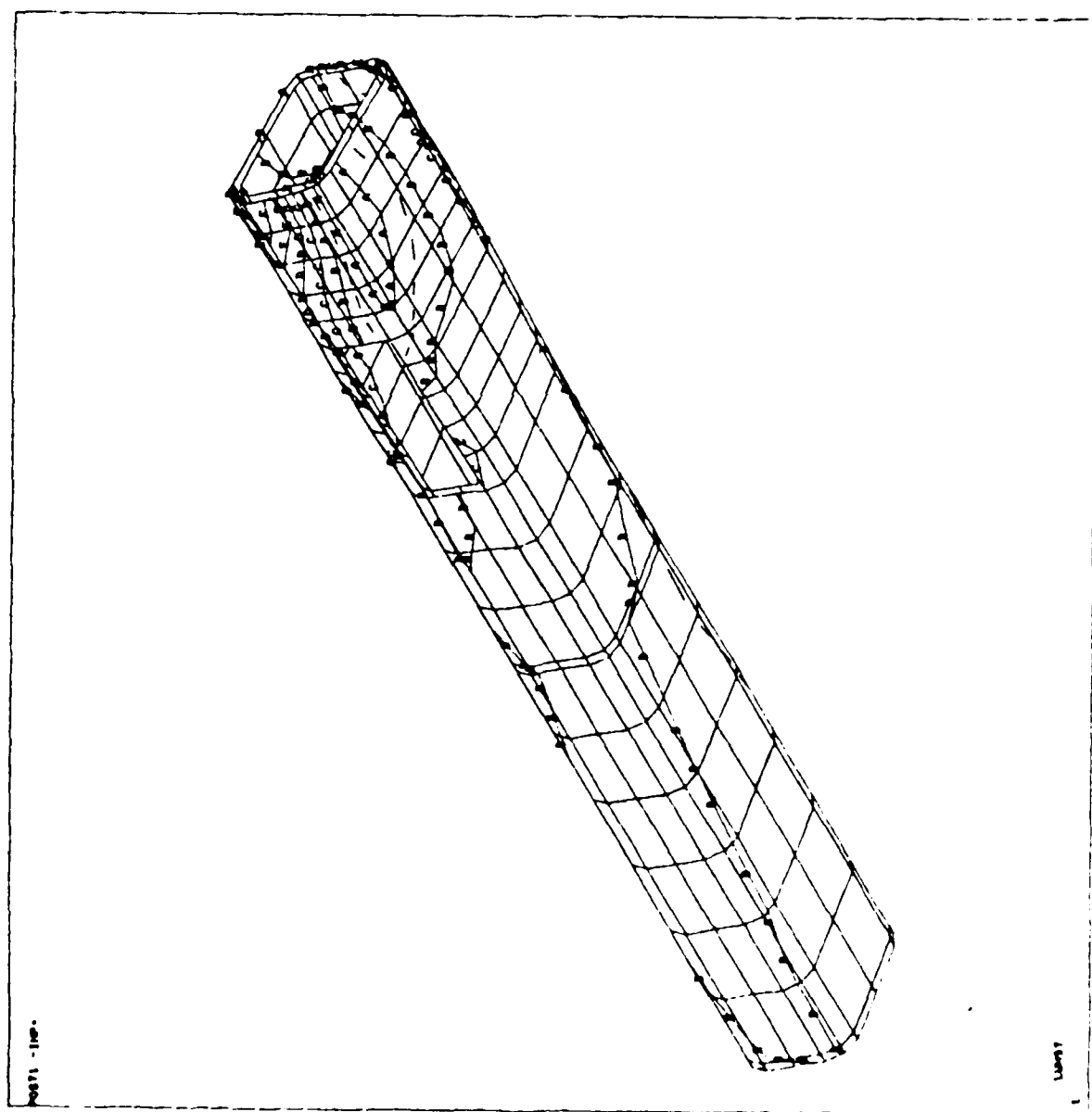
AMYS 4.20
 NOV 25 1966
 0409130
 POST1: STRESS
 STEP=1
 ITER=1
 515
 20=1
 0137=1.36
 27=116
 CONE=45
 M180EN
 01=24732
 01=82236
 01=74099
 01=55064
 01=37821
 01=18682
 01=1543
 F=16586



44035 4.28
 NOV 26 1966
 9132127
 POSTI SYMBIOS
 5750-1
 1708-1
 375
 20-1
 8157-126
 27-116
 CONE-46
 MIDEA
 RA-8534
 RW-4528
 A-3820
 B-2508
 C-1496
 D-484
 E-520
 F-1840



APPV 4.23
 MOD PS 1005
 8/10/27
 POST1 SYM06
 STEP=1
 LVEB=1
 SAS
 PU=1
 VU=1
 ZU=1
 D187=104
 D7=110
 M180EN
 M2=721.2
 M3=1003
 A=645
 B=655
 C=1075
 D=3206
 E=4506
 F=5005

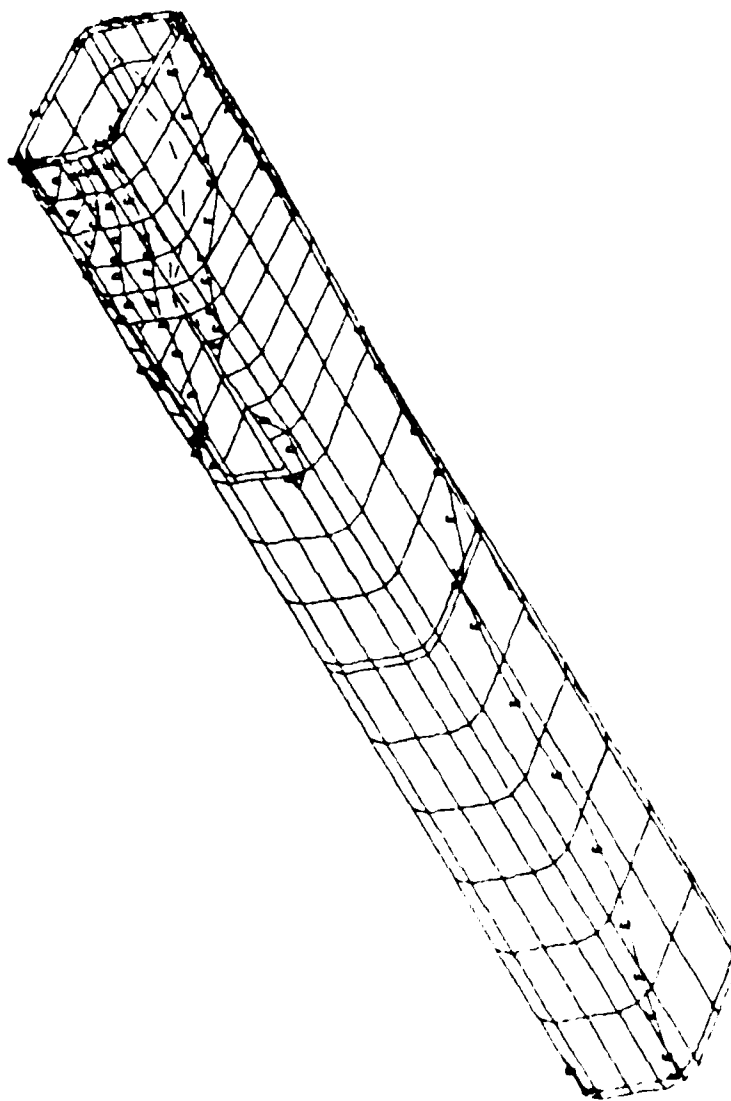


2017-100

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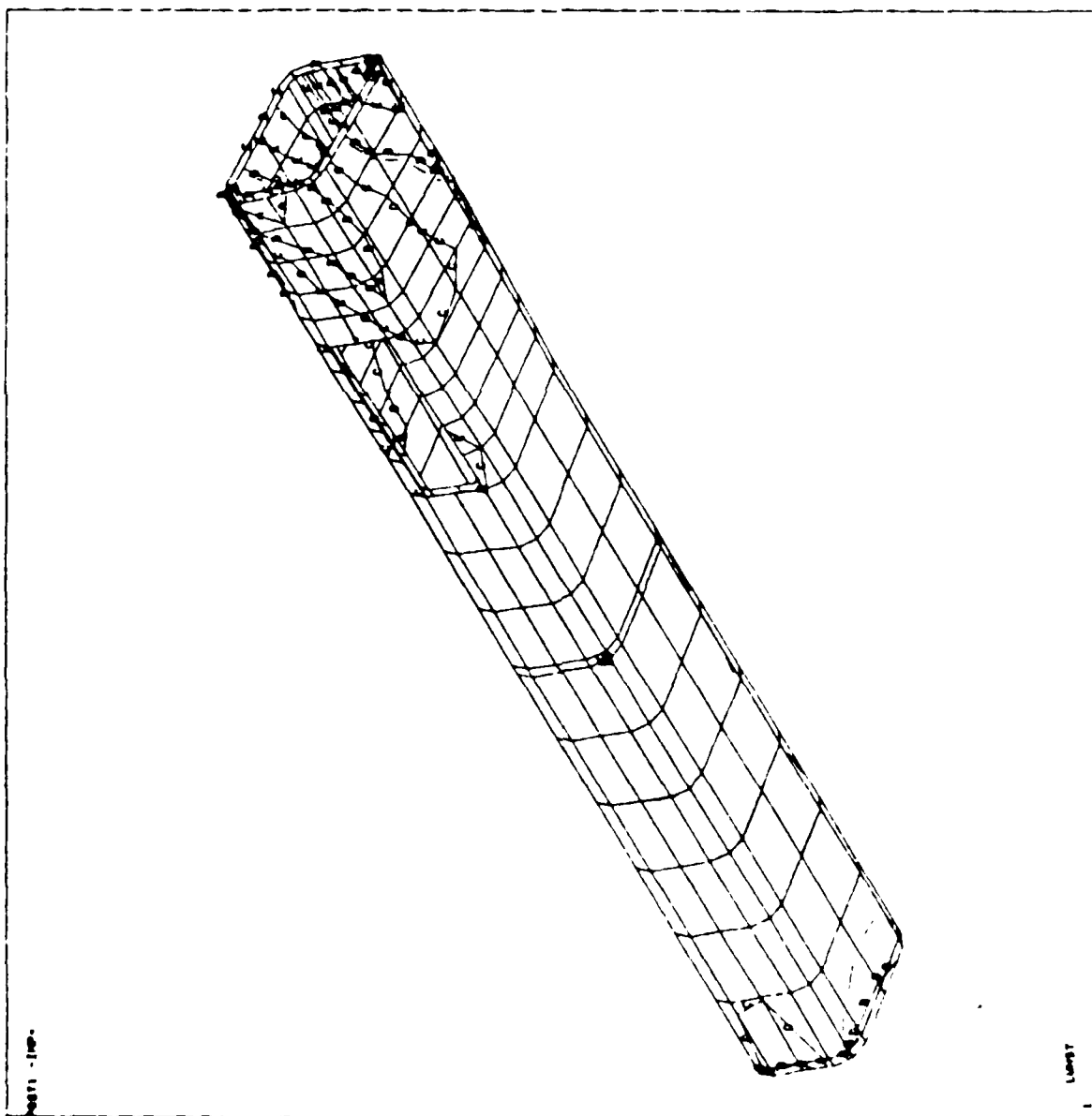
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100-110000-1000

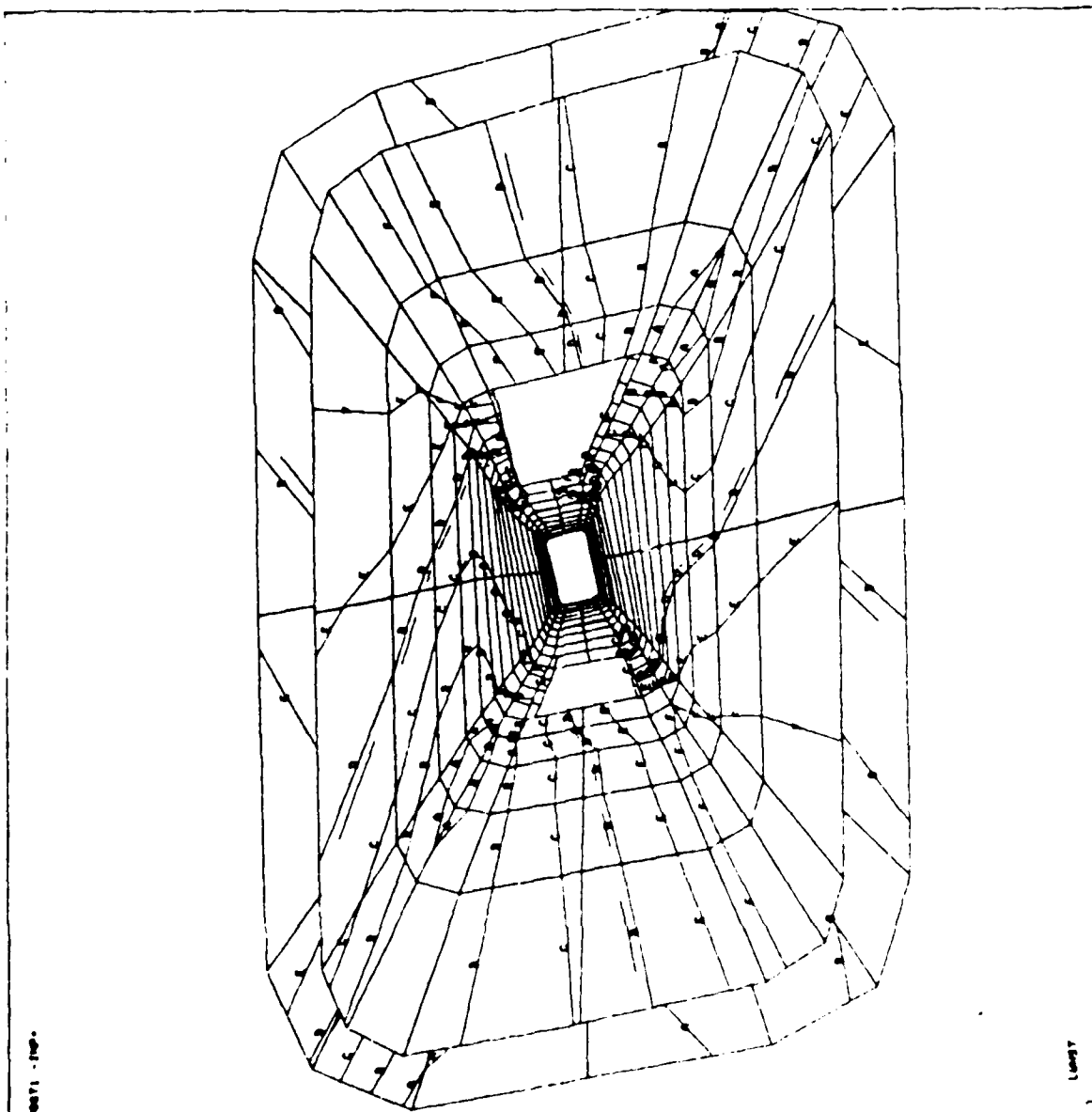


1

AMB 4.20
 NOV 25 1966
 8:03:03
 POST/STRESS
 STEP=1
 ITER=1
 SVS
 RV=1
 VU=1
 ZU=1
 D(ET)=104
 ZF=110
 M(DD)=
 RU=8700
 MU=3343
 A=2400
 D=1015
 C=760
 D=115
 E=800
 F=1805



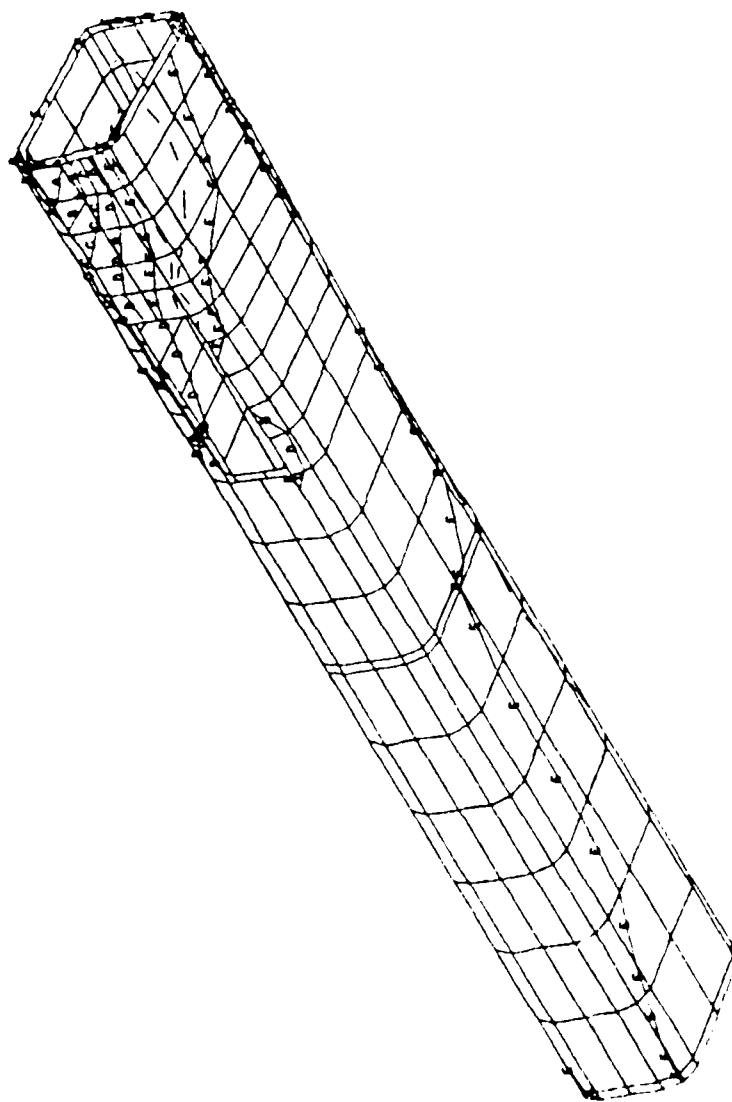
000-545 0-20
NOV 25 1965
9:30:43
POST-1 STAGE 6
STAGE-1
1728-1
545
20-1
0157-175
27-116
COND-46
M1026H
RM-2709
04--2343
0--2400
0--1815
C--750
0-115
E-050
F-1045



A complex technical drawing of a mechanical part, likely a turbine or compressor housing, showing a cross-section with a central inlet and multiple internal passages. The drawing is a line drawing with a grid of lines and a central square opening.

16097

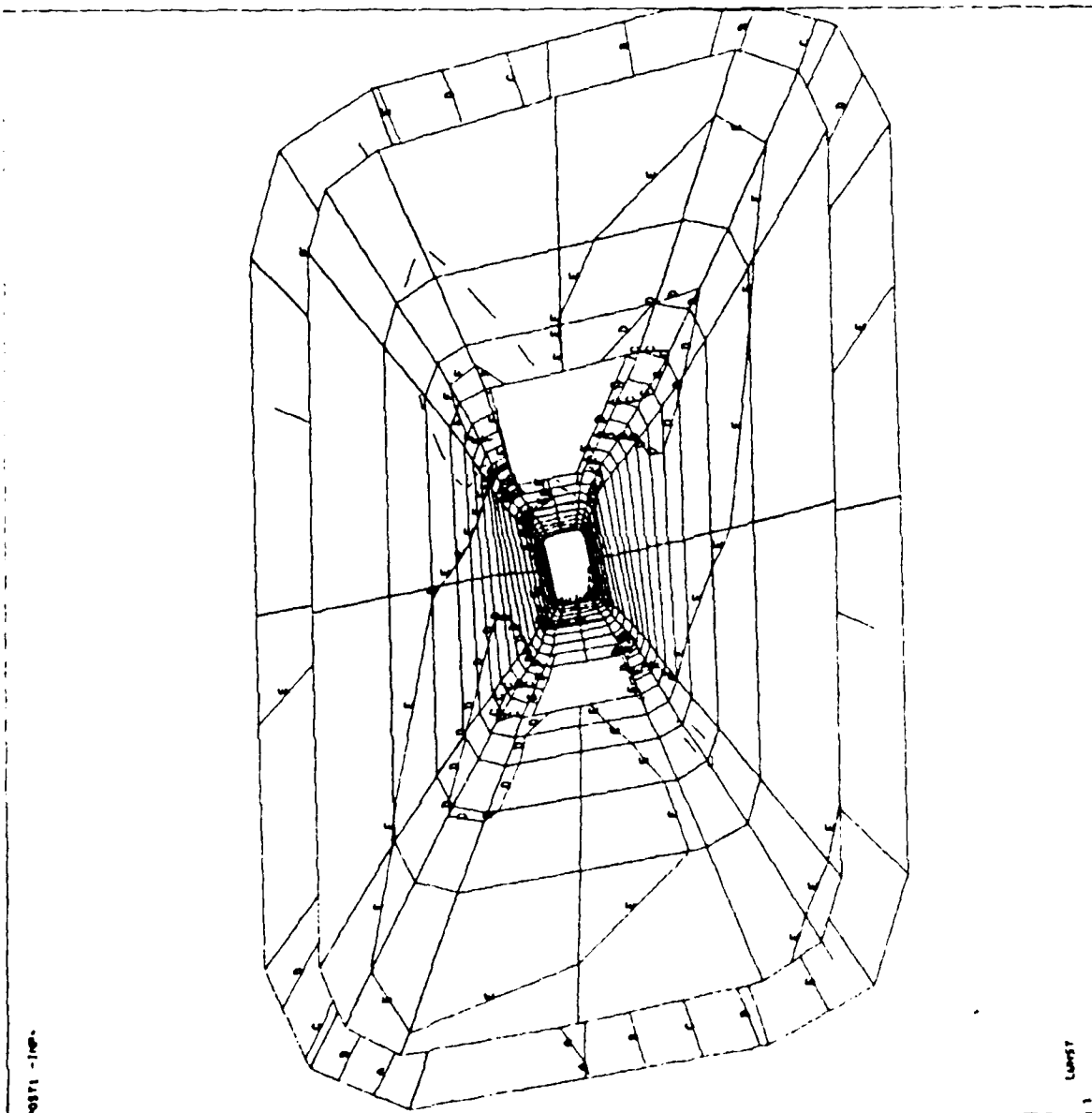
ANALYSIS 4.28
 NOV 25 1986
 8117146
 POST1 STRESS
 STEP=1
 ITER=1
 SRT
 PU=1
 VU=1
 ZU=1
 DIST=104
 ZF=118
 MIDDEN
 NU=64740
 MU=145845
 A=118675
 B=91404
 C=64173
 D=26942
 E=9711
 F=17620



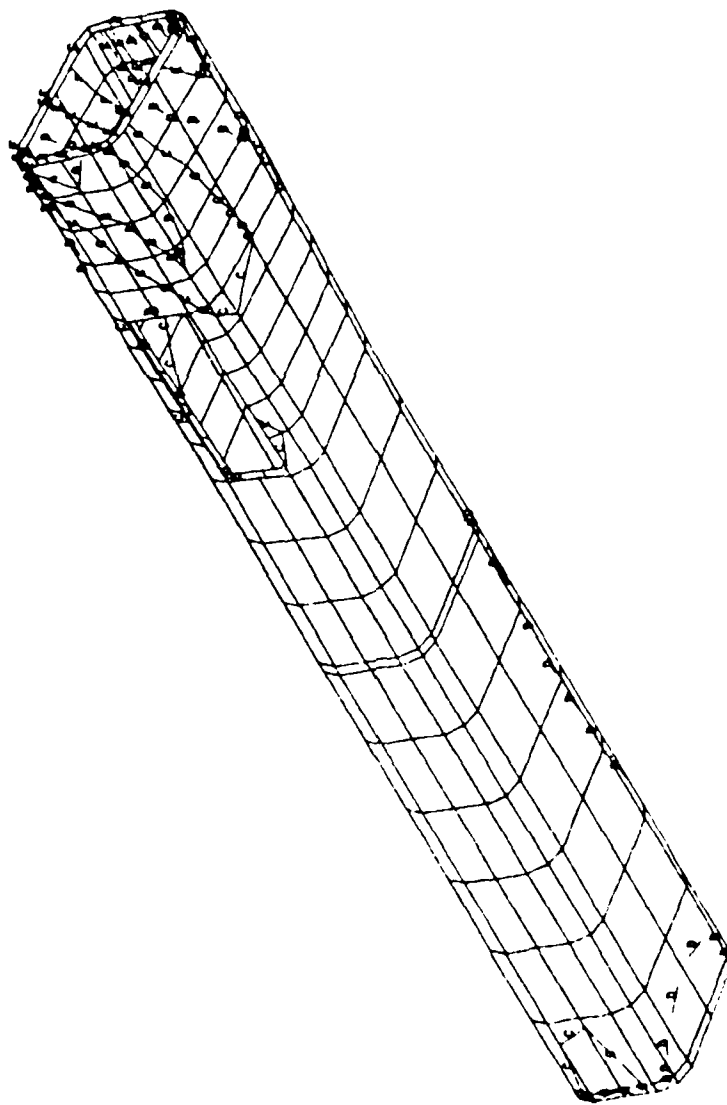
POST1 (PLOT)

11/25/86

ANSYS 4.28
 NOV 25 1985
 91441.00
 POST1, STRESS
 STEP=1
 ITER=1
 SXT
 ZU=1
 DIST=135
 ZF=116
 CME=46
 MIDDLE
 WA=44749
 MM=145685
 A=118635
 B=91404
 C=64173
 D=36942
 E=9711
 F=17620

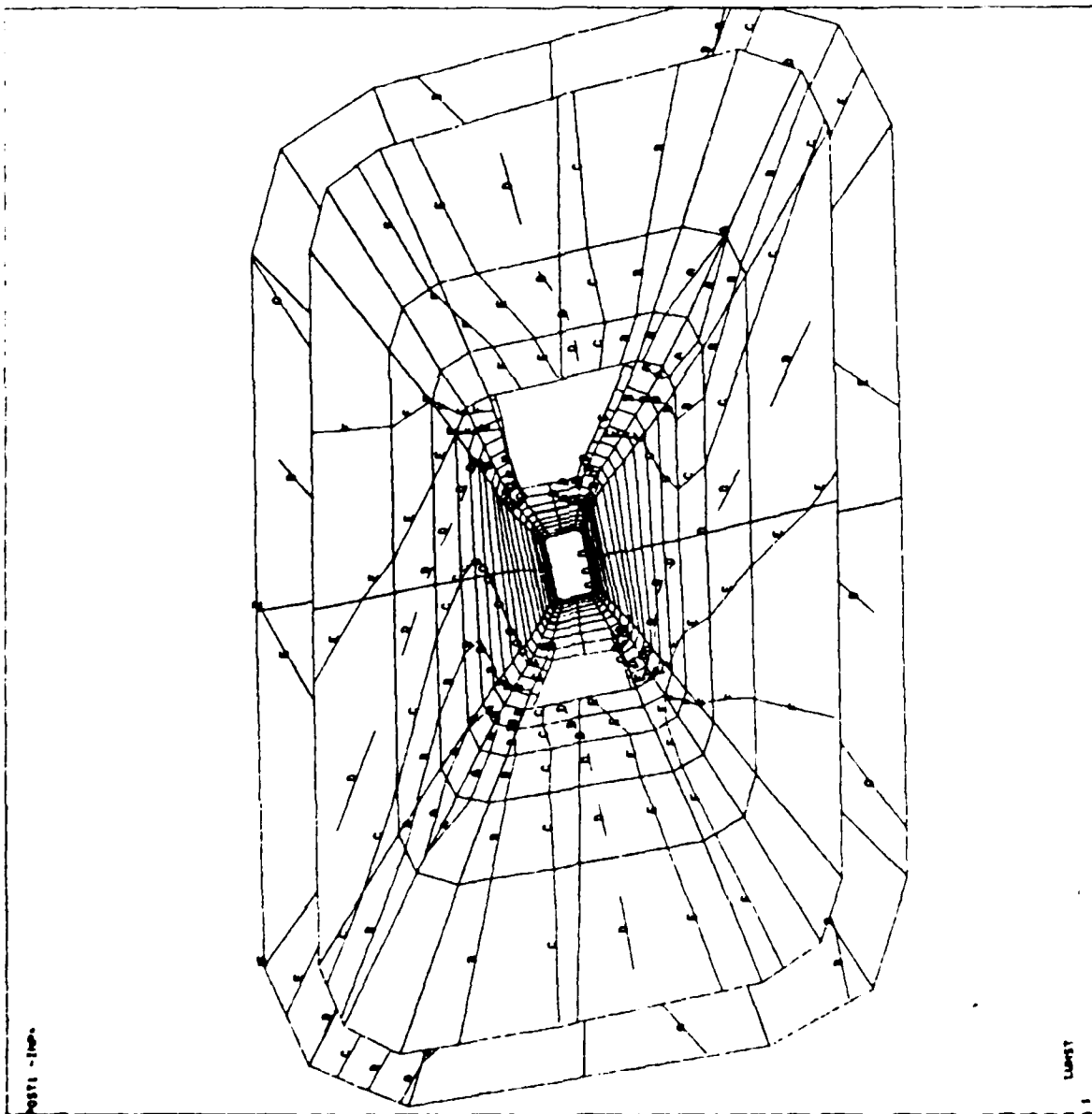


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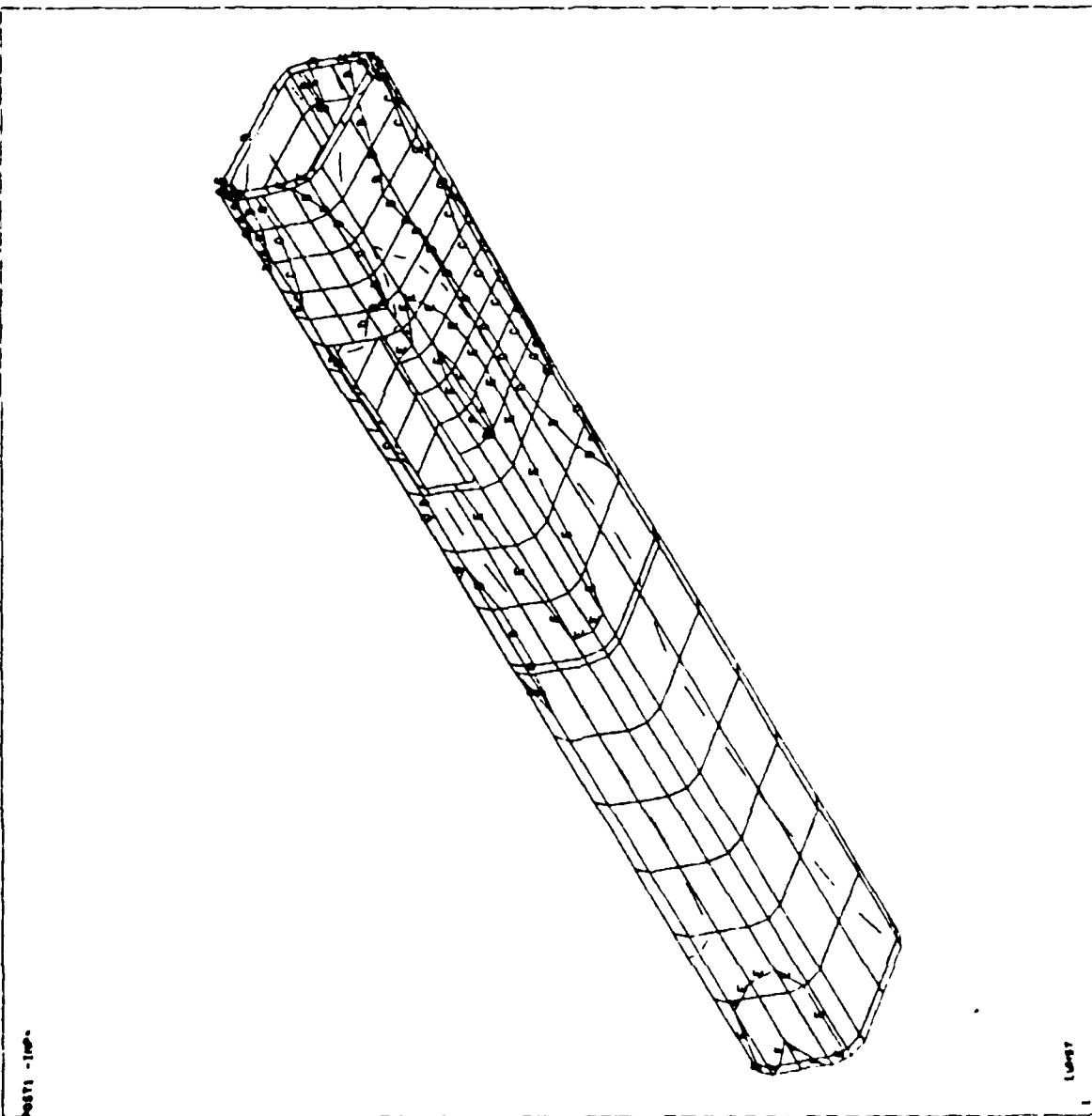


13097

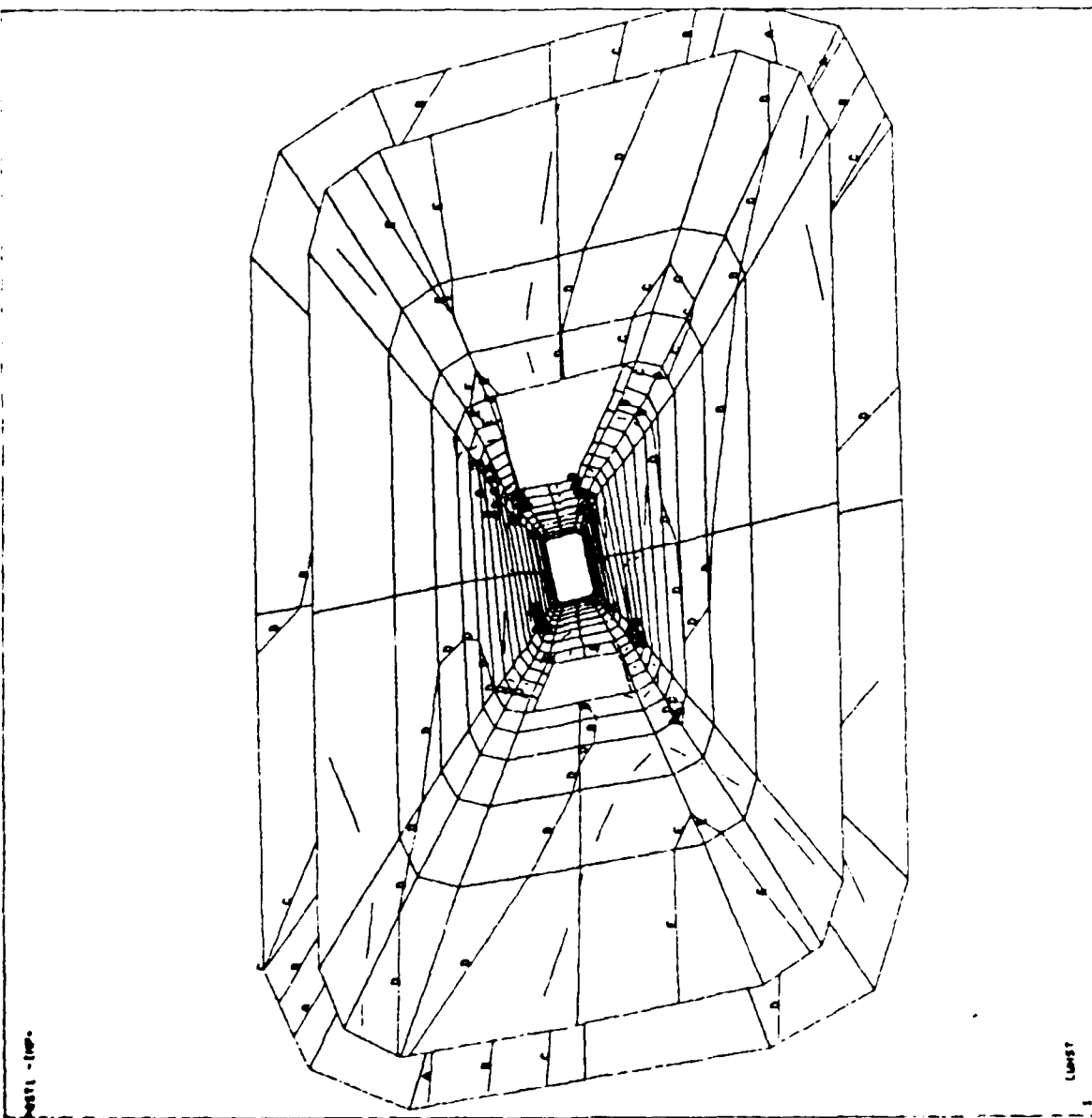
000115 4.20
 NOV 26 1988
 10142103
 POST1 STRESS
 STEP=1
 ITER=1
 0.7
 20=1
 0187-134
 27-116
 COME-48
 M1888
 PA-8840
 MO-1308
 A--3324
 B--1880
 C--836
 D=0
 E-844
 F-1880



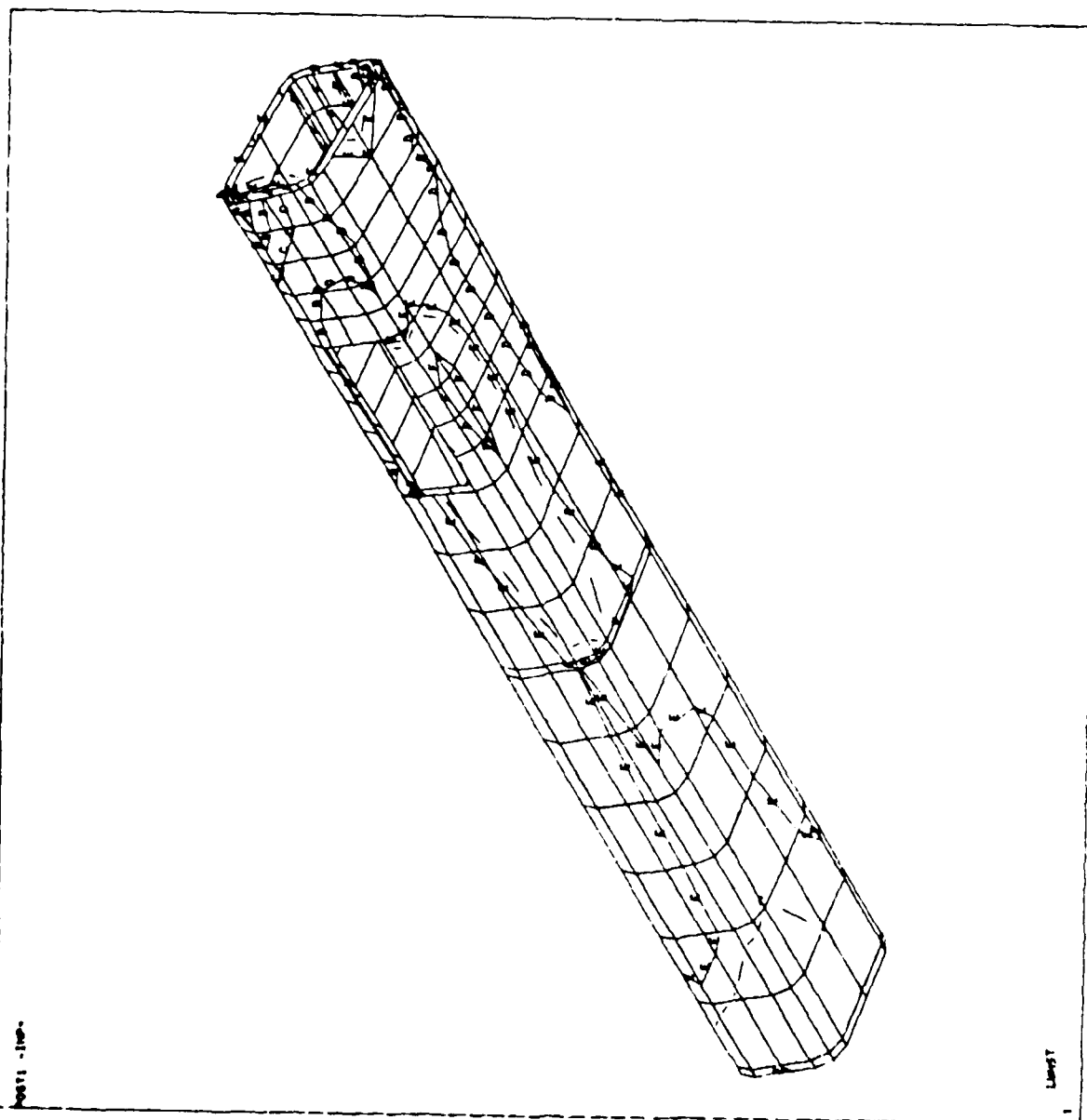
ANALYSIS 4.20
 NO. 25 1006
 18/28/22
 POST1 STRESS
 STEP=1
 IYER=1
 847
 RU=1
 VU=1
 ZU=1
 B1ST=104
 ZF=110
 M1B0CM
 RU=2478
 RU=4164
 A=3897
 B=2889
 C=1311
 D=383
 E=585
 F=1833



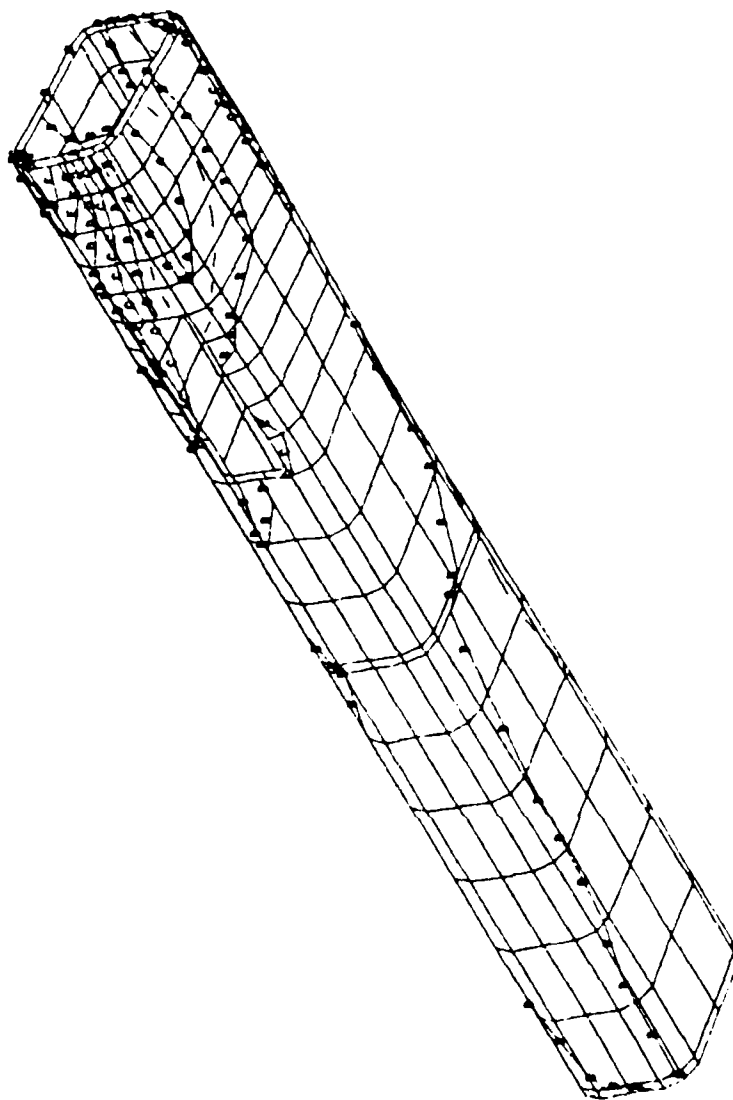
ANALY 4.28
NOV 25 1966
10144104
POST1 STRESS
STEP=1
ITER=1
END
20=1
DIST=134
EP=116
CONE=48
MIDCH
PR=2479
PR=4154
A=3207
B=2259
C=1211
D=263
E=585
F=1533



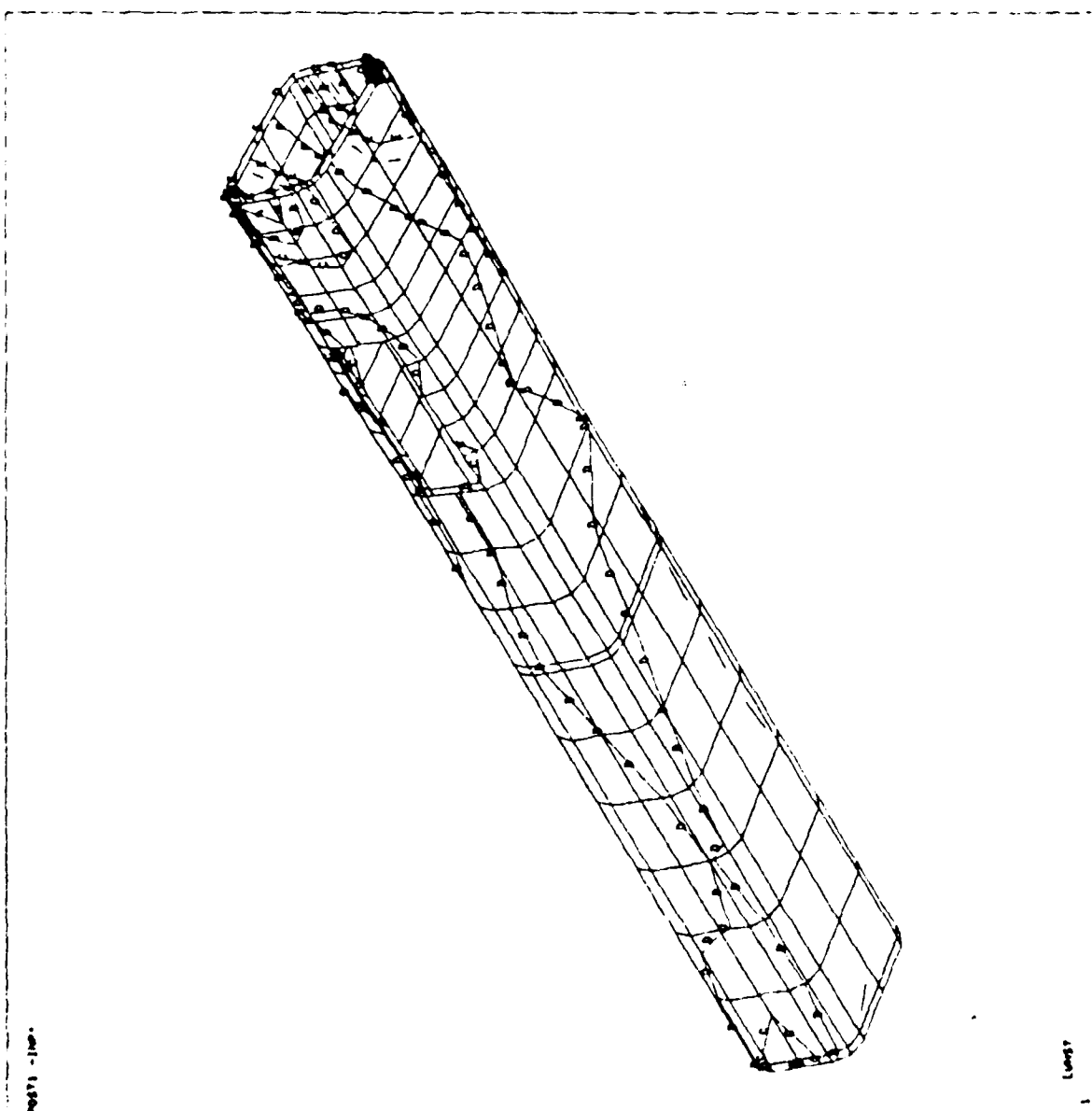
ANALYSIS 4.00
 NEW 25 1005
 10110124
 POST11 5705.05
 STEP=1
 IYER=1
 300
 300--1
 300--1
 20--1
 0157--104
 20--110
 010024
 01--20387
 001--00501
 0--74795
 0--50000
 C--30991
 0--21004
 E--3197
 F--14700



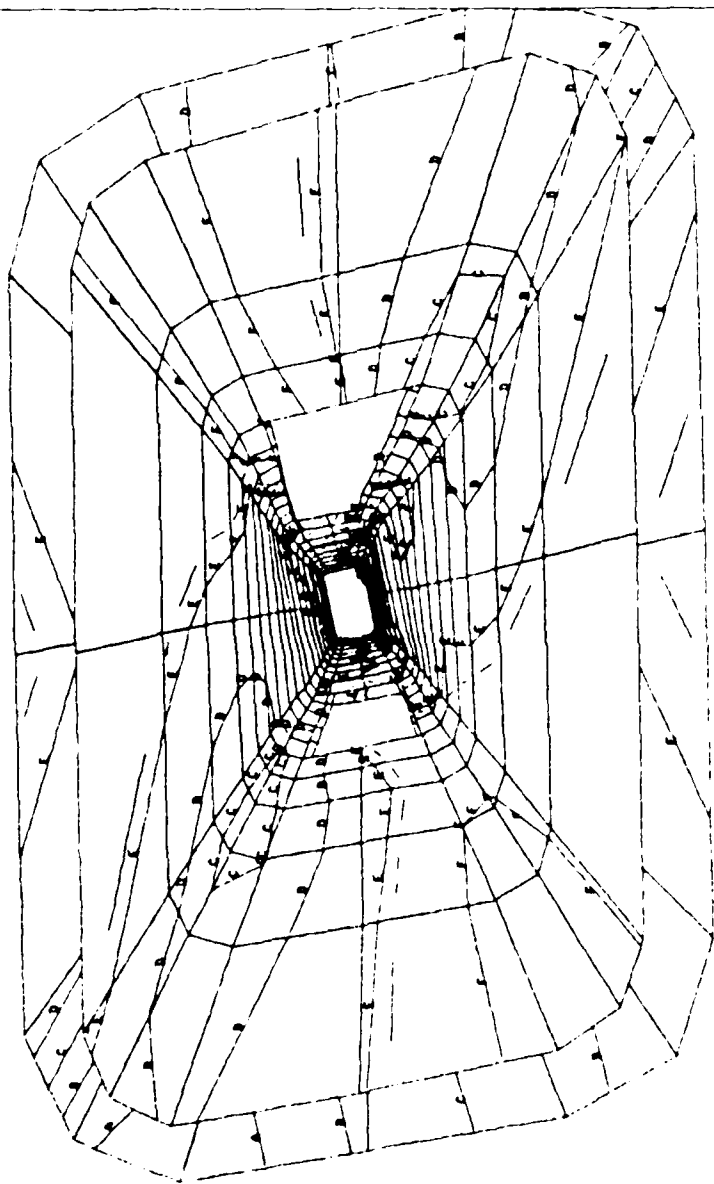
08974 4.25
MO-21 1686
MO-21/146
POS71 STG55
STP-1
JTEA-1
640
NO-1
VO-1
VO-1
NO-1
ZV-1
0157-104
ZF-116
M1004
RA-718
MA-1975
B-676
B-625
C-1806
C-2227
E-6528
F-6959



ANSYS 4.20
NOV 25 1986
18:09:37
POST1, STRESS
STEP=1
ITER=1
SVR
N=1
M=1
P=1
DISP=104
Z=116
MIDEL
PL=2268
PR=4569
A=3695
B=2600
C=1833
D=657
E=310
F=1205



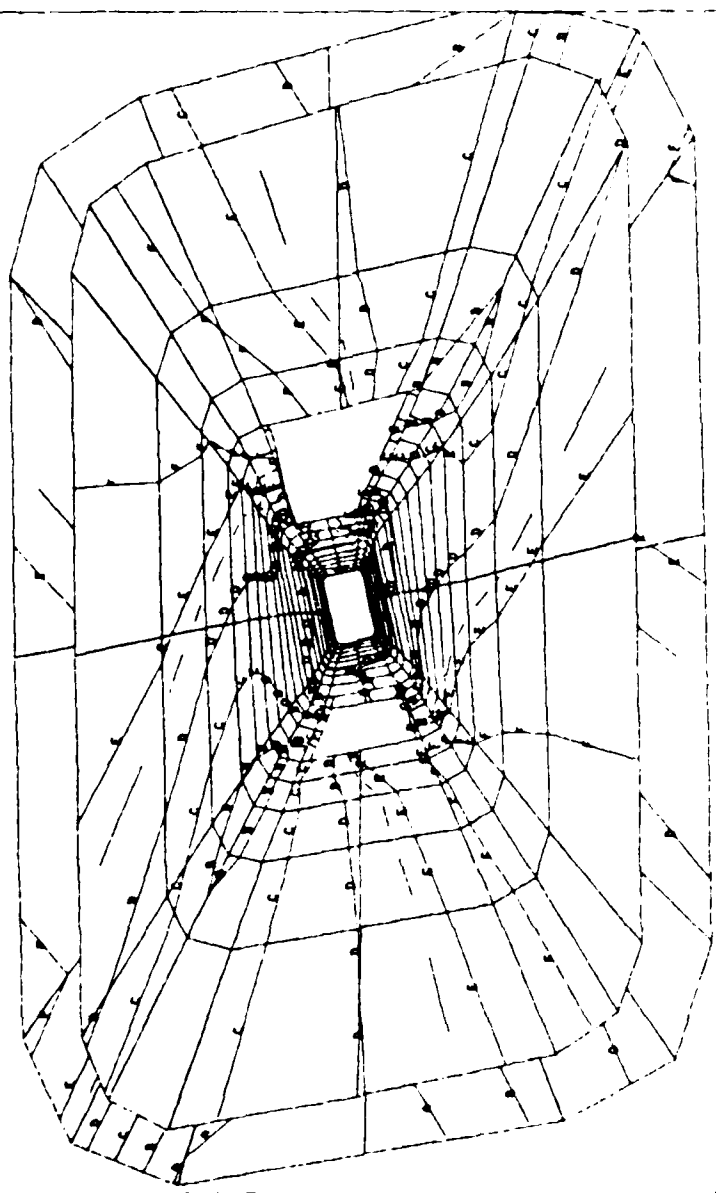
00000 1.20
 MON 25 1966
 10:40:16
 POST1 STAGE
 STEP=1
 ITER=1
 519
 20=1
 3187-134
 27-116
 COME-48
 WIDEN
 PA-12587
 PA-14421
 A-17795
 B-14228
 C-10901
 D-12189
 E-12187
 F-14700



POST1 -116-

10000

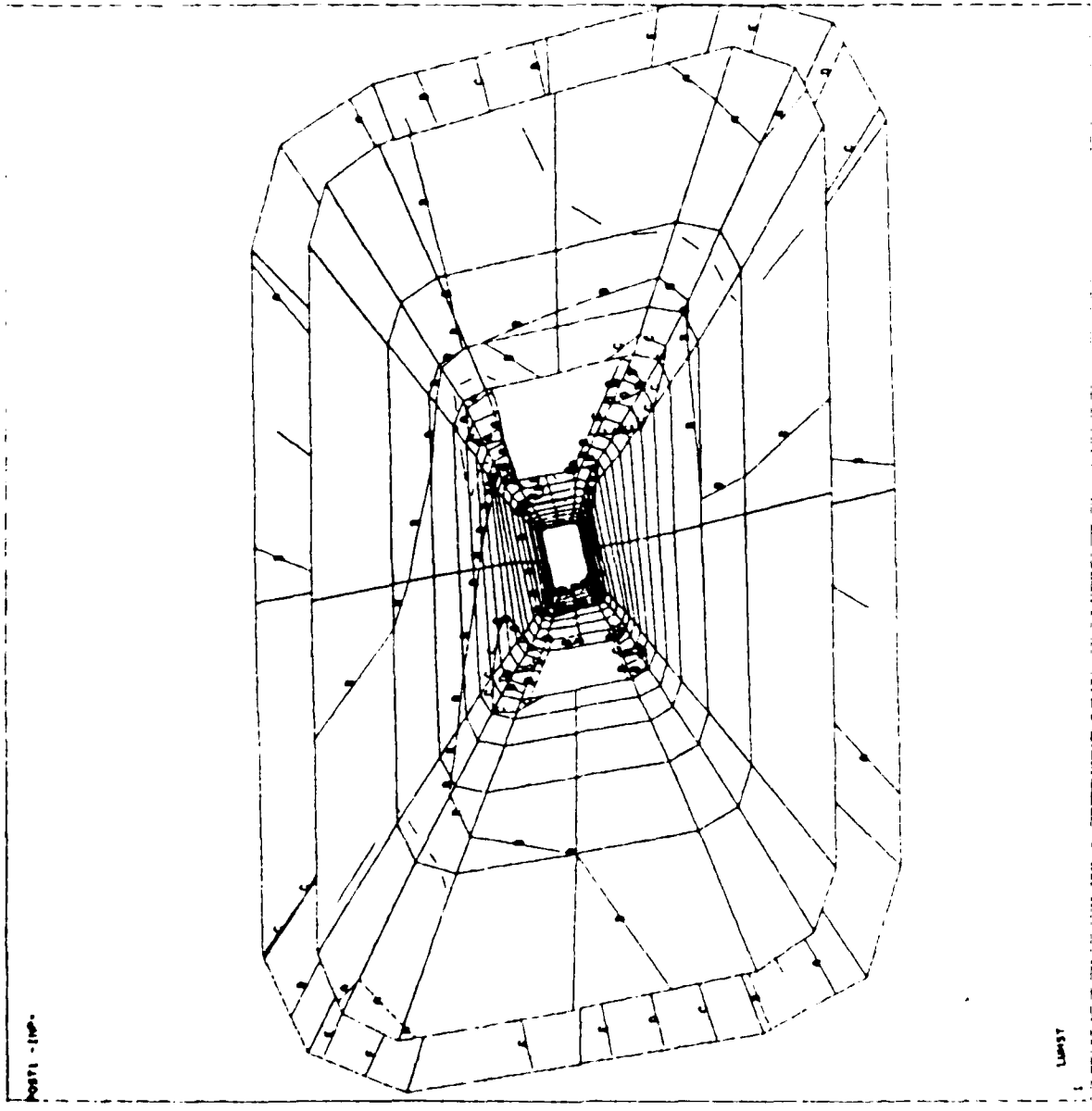
ANALYSIS 4.20
 NOV 25 1966
 10:40:40
 POST11 STRESS
 STRESS
 11700.1
 5VE
 20-1
 0151-134
 27-116
 COME-40
 M18M7N
 RA-2260
 RA-4559
 A-3685
 B-2600
 C-1633
 D-657
 E-310
 F-1275



POST11 - 1000

11700.1

ANALYSIS 4.25
NOV 20 1986
10-12-03
POST1 5THG10
STEP=1
TIME=1
END
20=1
B1C1-134
Z1-116
CONC=48
MIDDM
R1-7129
R2-1975
A1-676
B1-625
C1-1826
D1-2227
E1-6428
F1-8229

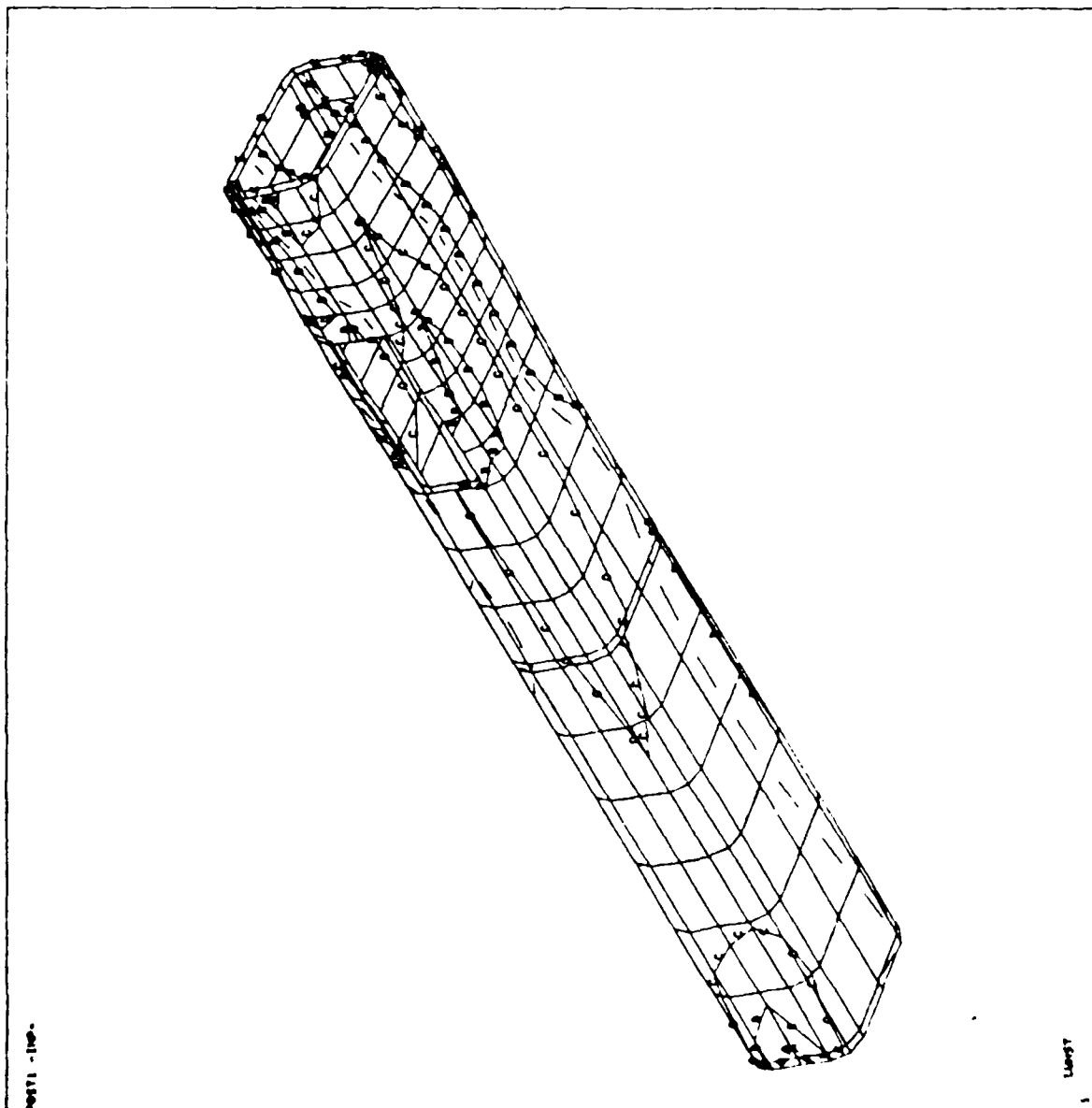


POST1 -100-

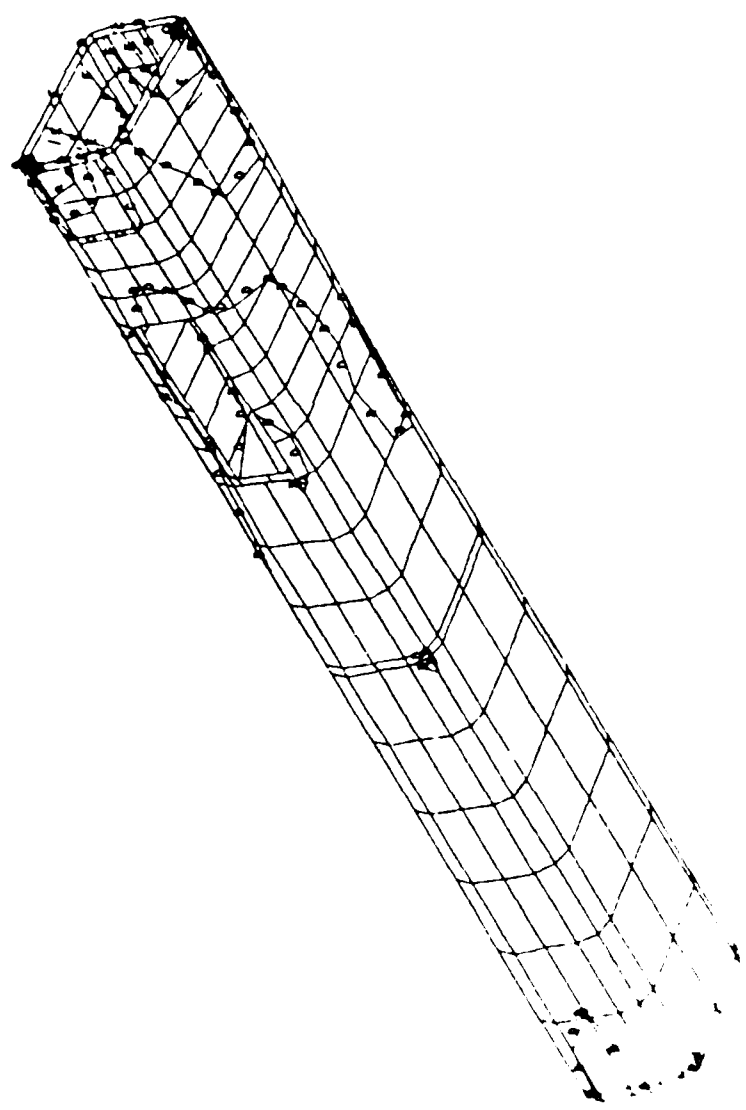
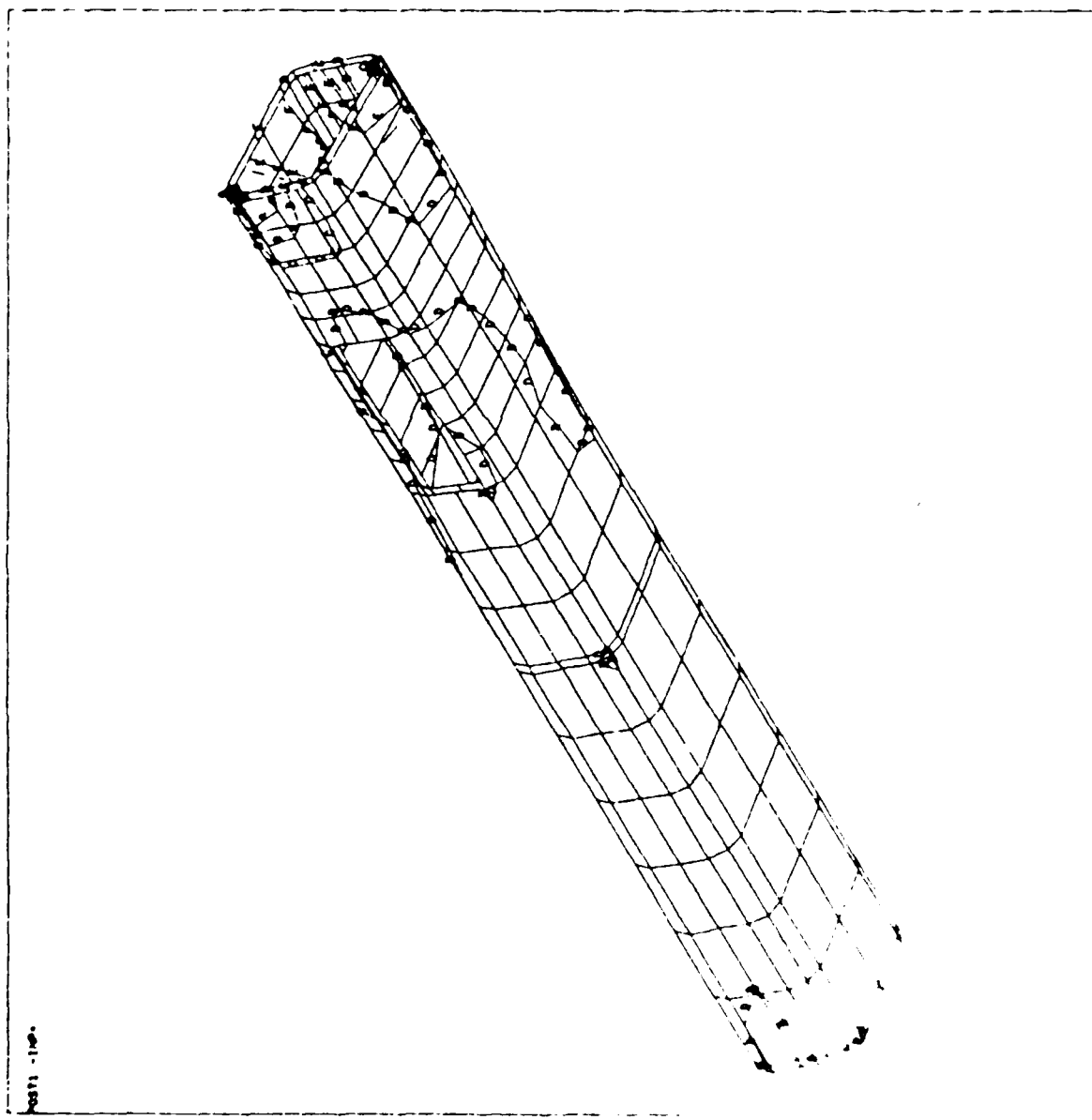
100000

08755 6.20
MAY 25 1968
10:22:42
POSTAL STREET
STEP-1
TTE-1
SUN

20--1
20--1
20-1
0157-104
27-118
W1902A
H2-47742
05--45575
4--40529
P-25420
C--(0431)
E-4818
E-19687
F-37416



4085-10 4.70
 4085-11 4.70
 4085-12 4.70
 4085-13 4.70
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 4085-100 4.70



AD-A183 992

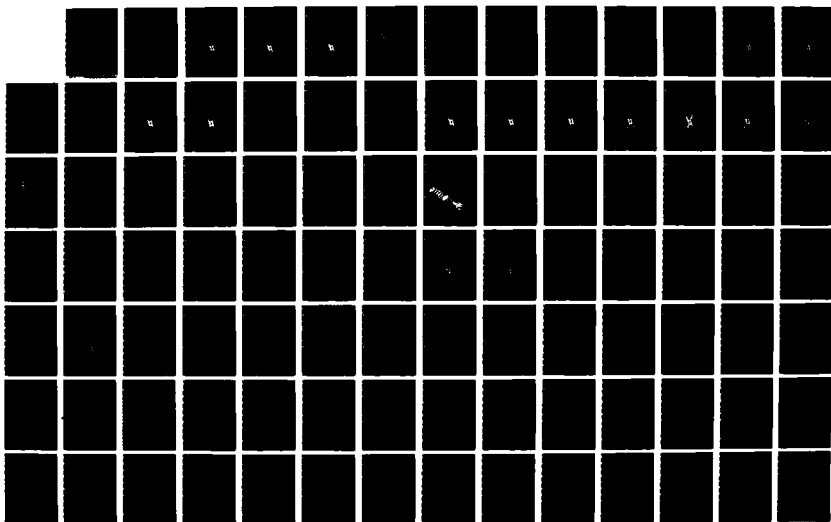
LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND
PARTIAL PHASE 2 VOLUM (U) FMC CORP MINNEAPOLIS MINN
NORTHERN ORDNANCE DIV R RATHE ET AL APR 87
FMC-E-3041-VOL-D2-PT-4 DAAA21-86-C-0047

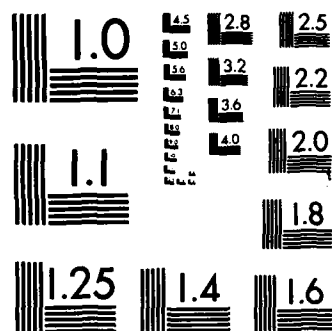
3/4

UNCLASSIFIED

F/G 19/6

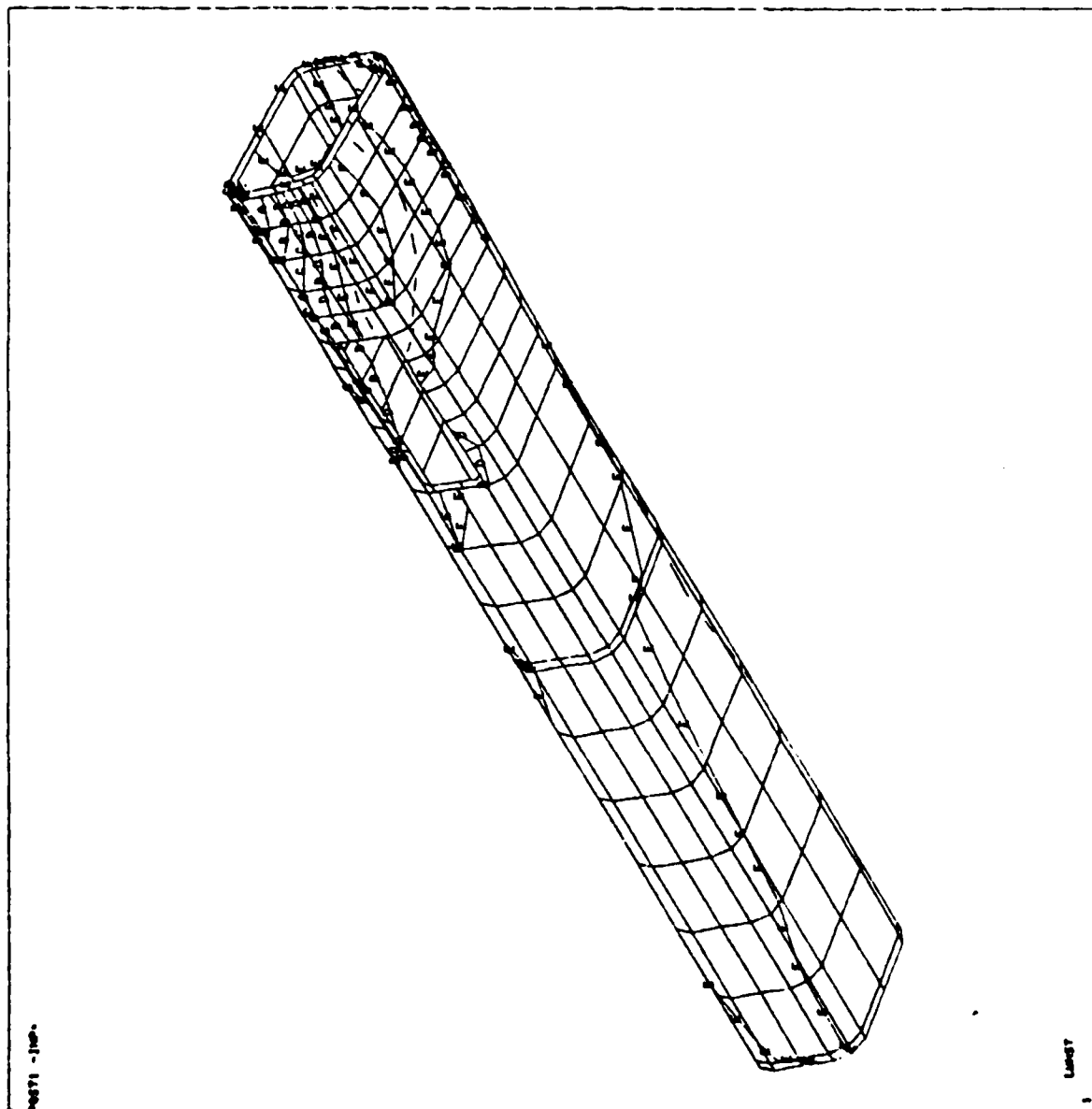
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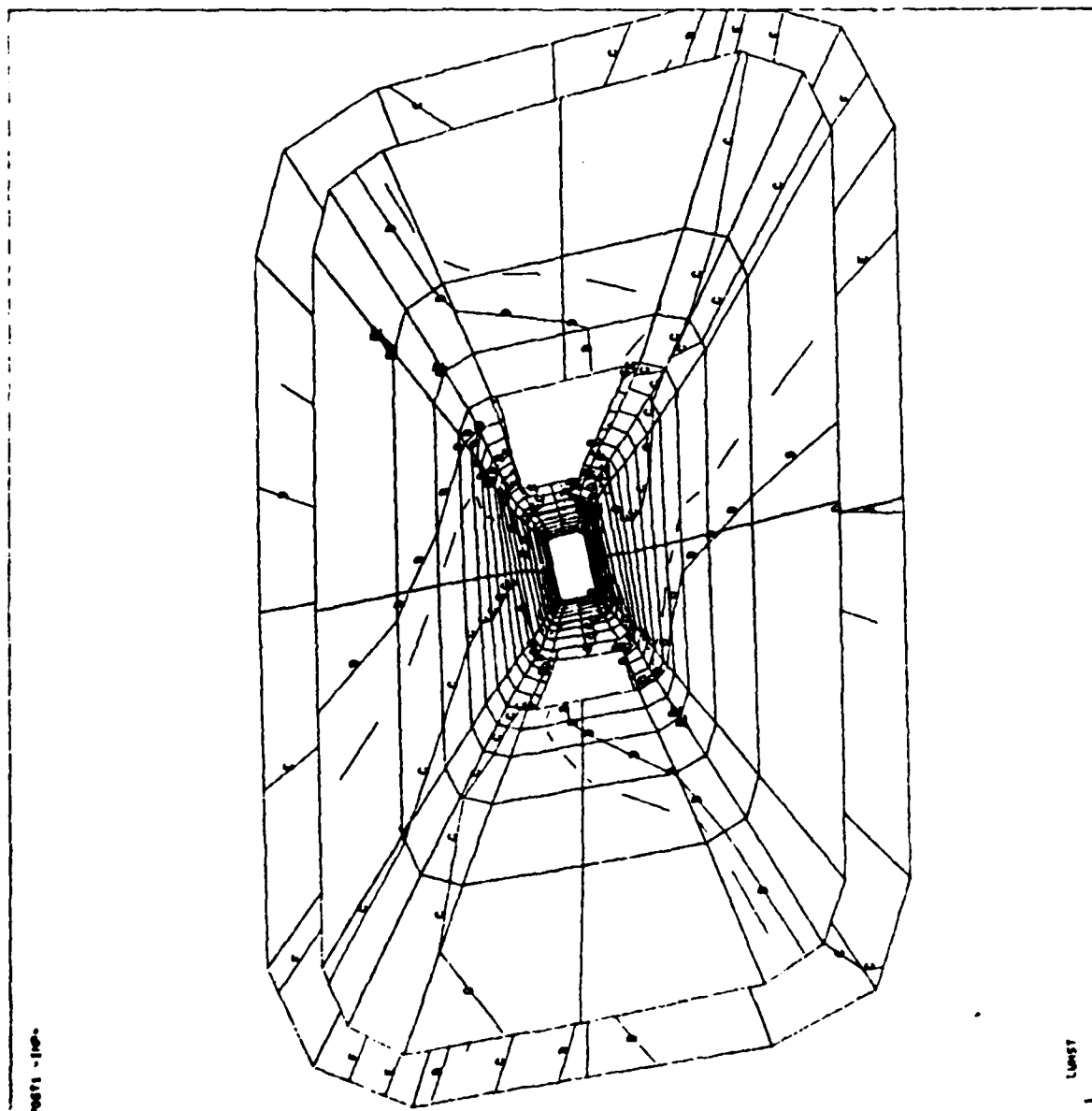


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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 NOV 25 1985
 10:34:16
 POST1 STRESS
 STEP=1
 ITER=1
 S40
 NO=1
 NO=1
 NO=1
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 27116
 M180W
 NO=1801
 NO=7100
 A=0811
 3--0812
 C--3213
 D--1914
 E--615
 F--084



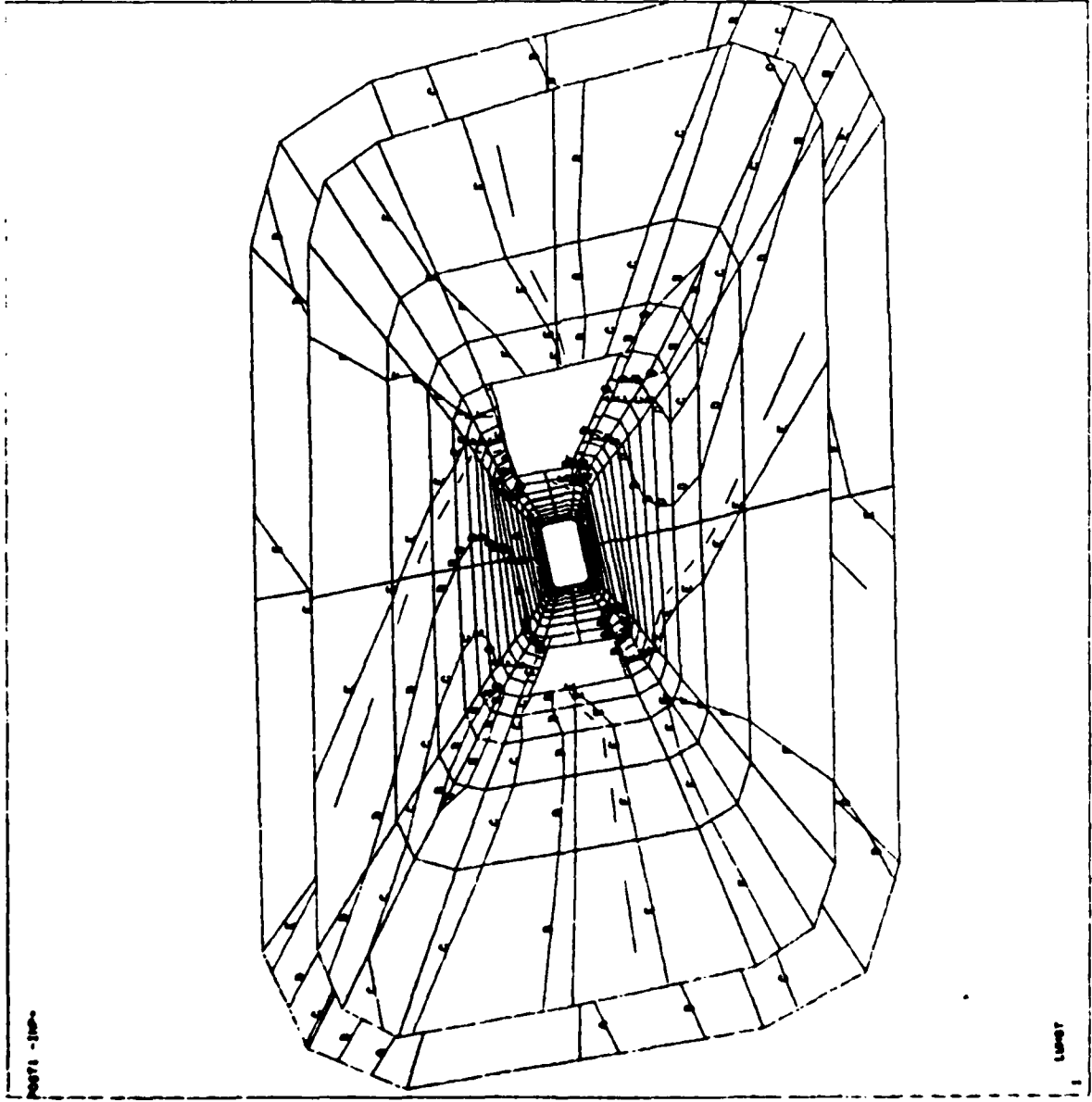
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 NOV 25 1965
 10154100
 POST1 SYMSE
 STEP=1
 ZTCR=1
 500
 20=1
 BIST=134
 2F=116
 CONE=48
 HIDDEN
 RH=48762
 AN=58676
 A=48829
 B=25488
 C=10431
 D=618
 E=18687
 F=34716



POST1 - 1000

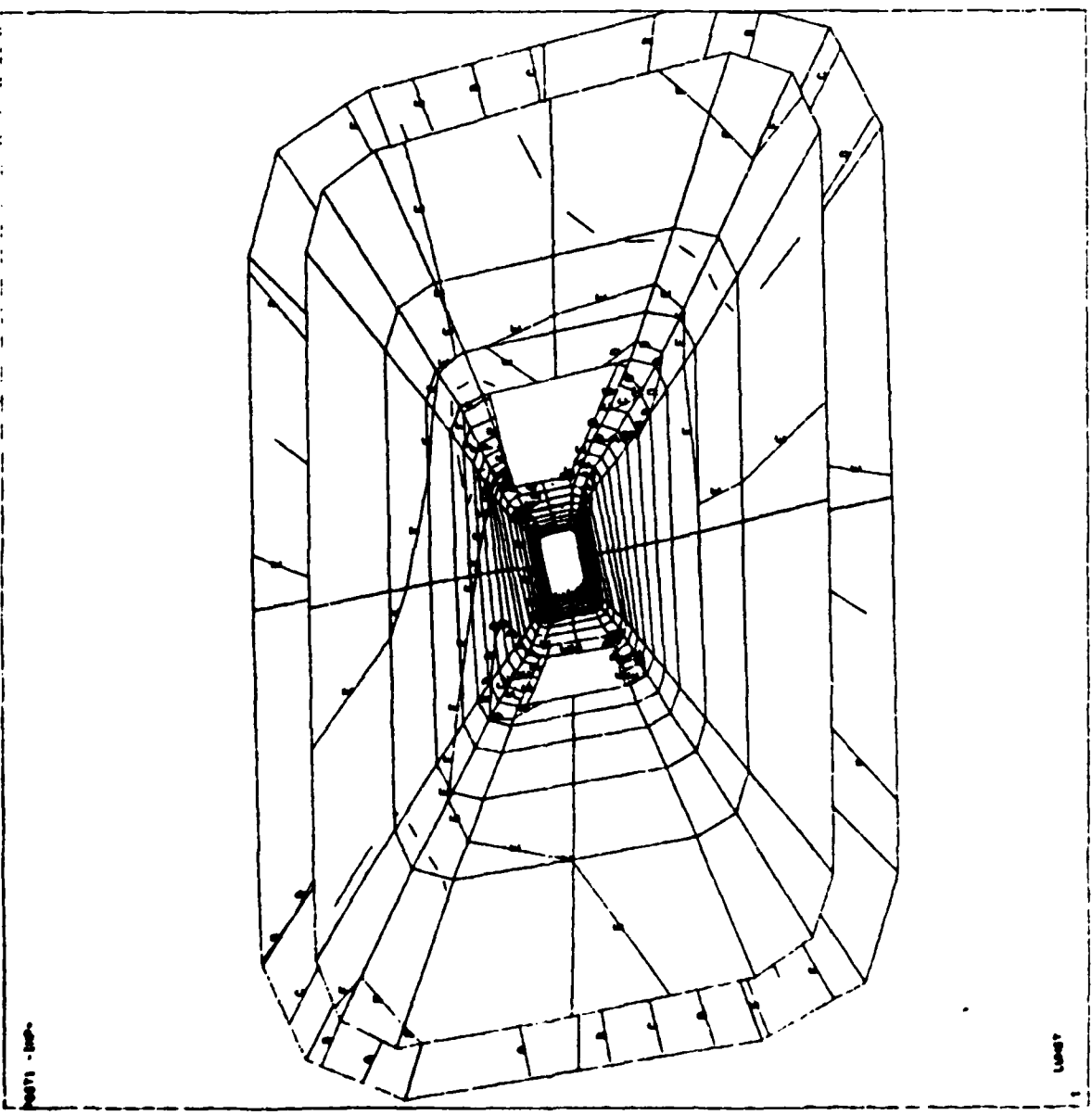
1000

ANALYSIS 4.00
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 10:55:59
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 1768.1
 879
 20.1
 DIST=134
 ZP=116
 COME=48
 HIDDEN
 RM=8584
 MM=5554
 A=-4208
 B=-3229
 C=-2046
 D=-993
 E=260
 F=1423

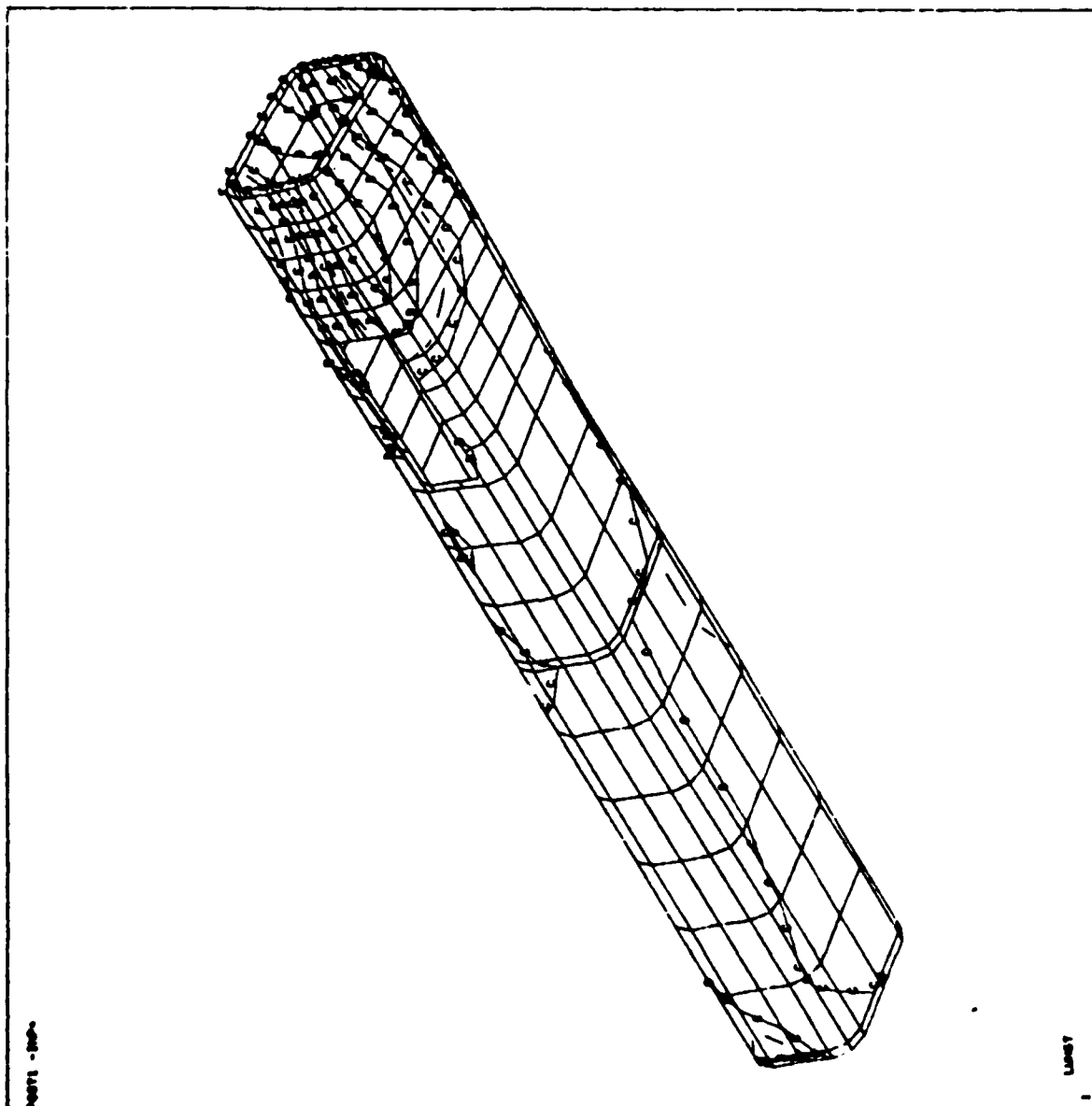


65

ANALYSIS 4.25
NOV 25 1980
1015752
POST1 STRESS
STEP=1
ITER=1
END
Z=1
DIST=134
SP=116
CONC=49
HIBEN
RD=1801
RM=-7100
A=-8811
B=-4512
C=-3213
D=-1014
E=-615
F=604



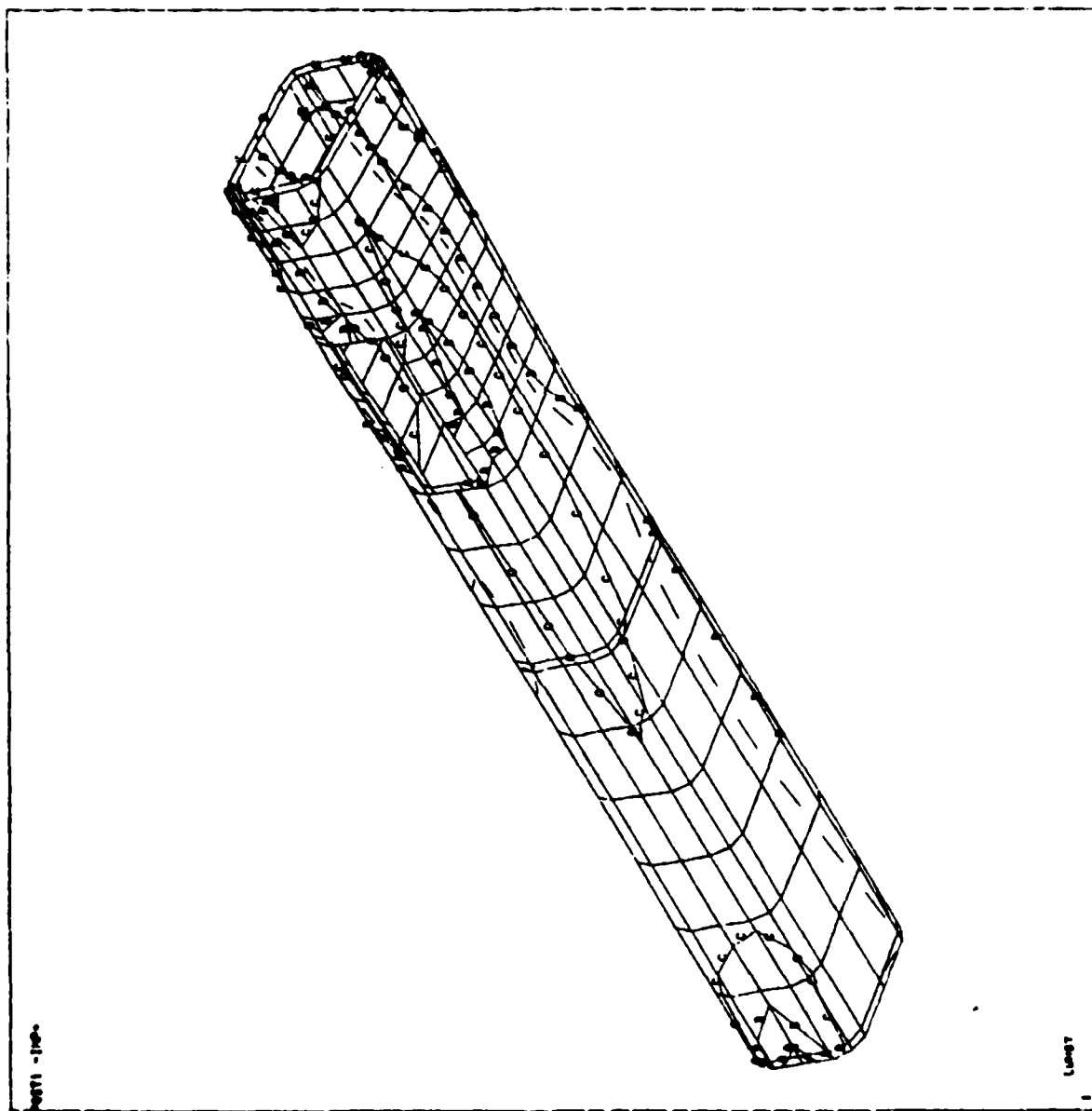
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 000 00 1000
 10100135
 00071 STRESS
 STEP=1
 ITER=1
 SIZE
 000=1
 000=1
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 0107-100
 27-116
 0100010
 00=61700
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 C=0004
 0=10001
 C=30000
 F=01705



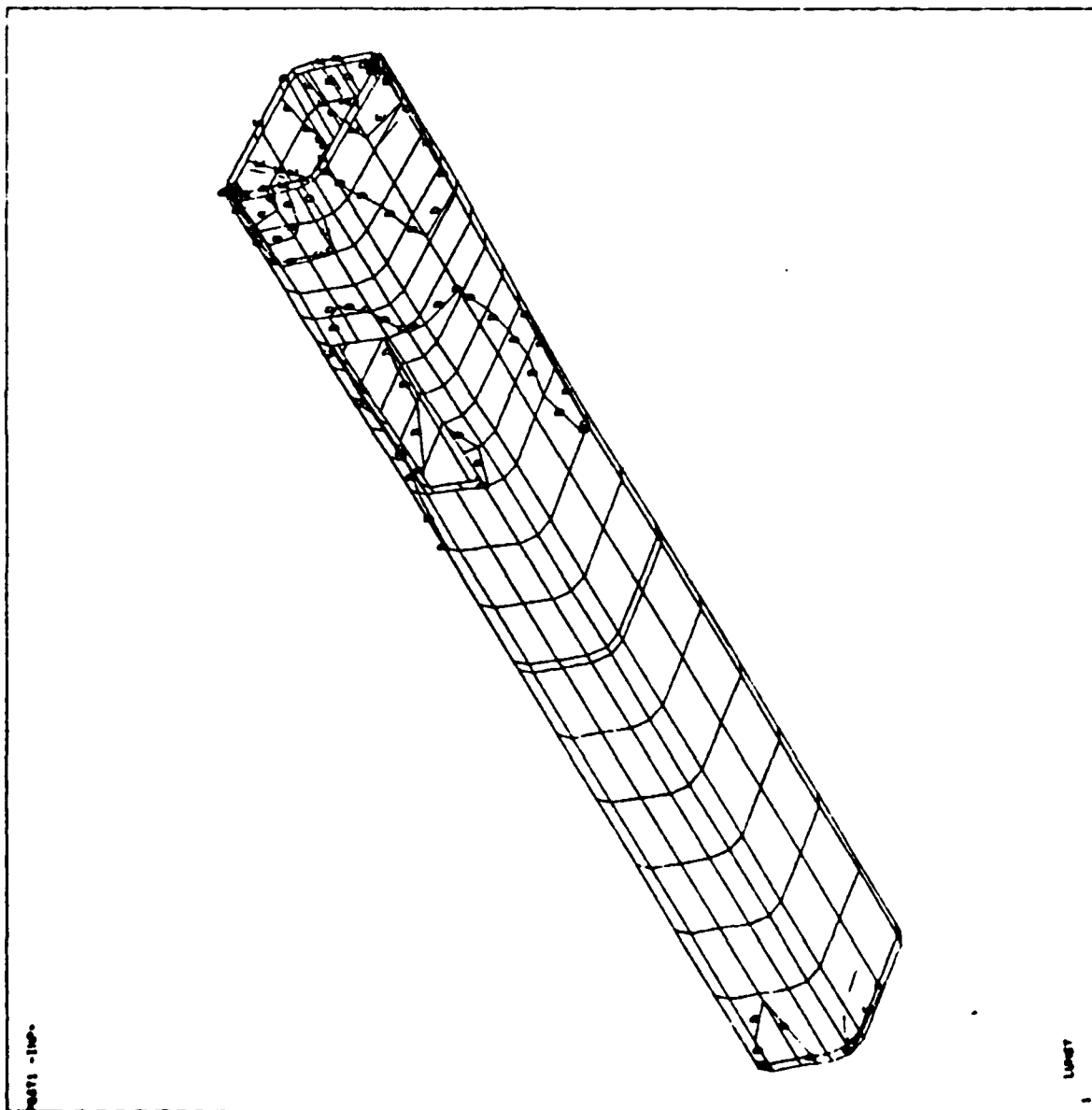
• 2016 - 2017

1957

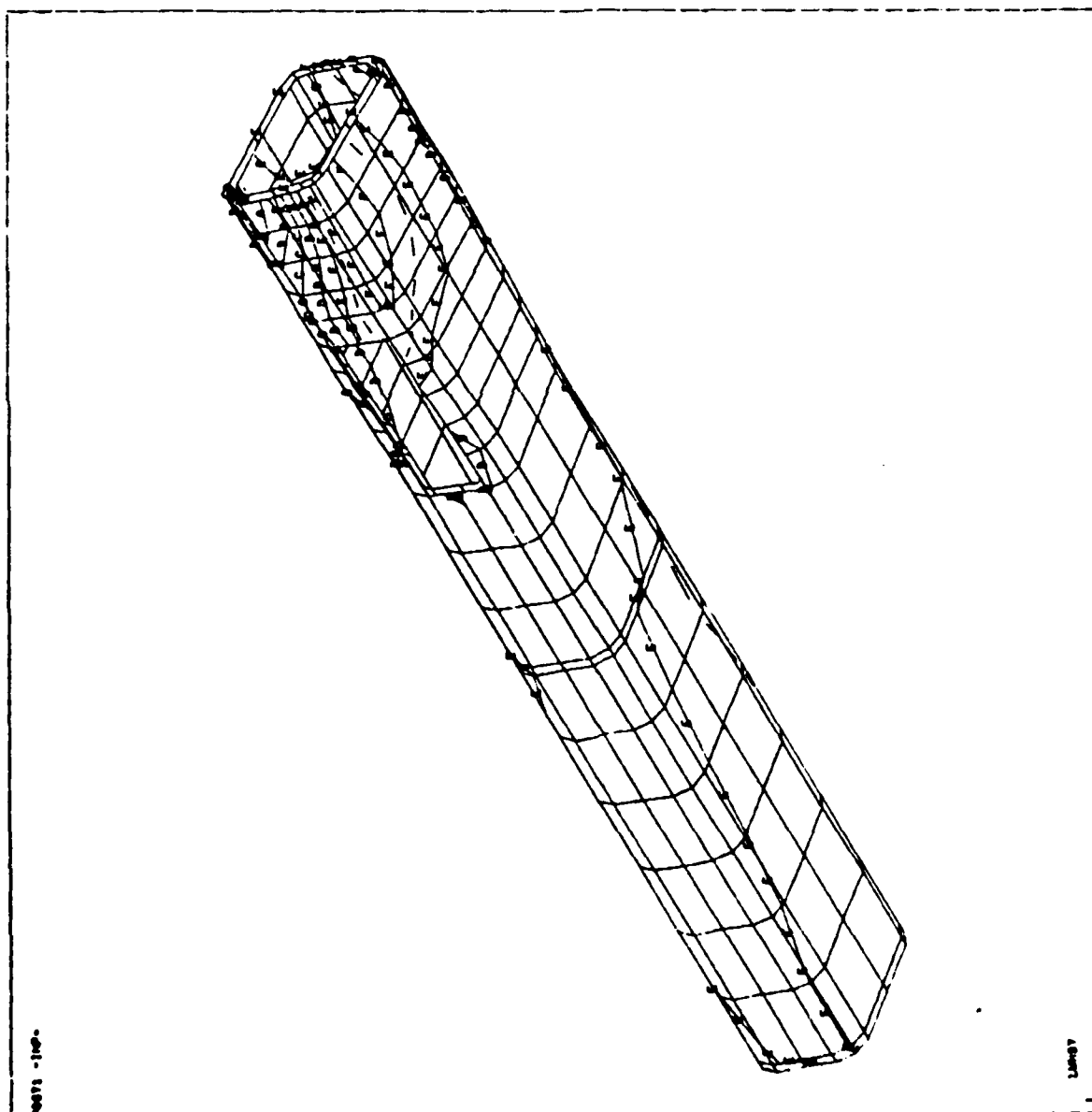
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 11:42:44
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 VO=1
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 B157-104
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 D=483
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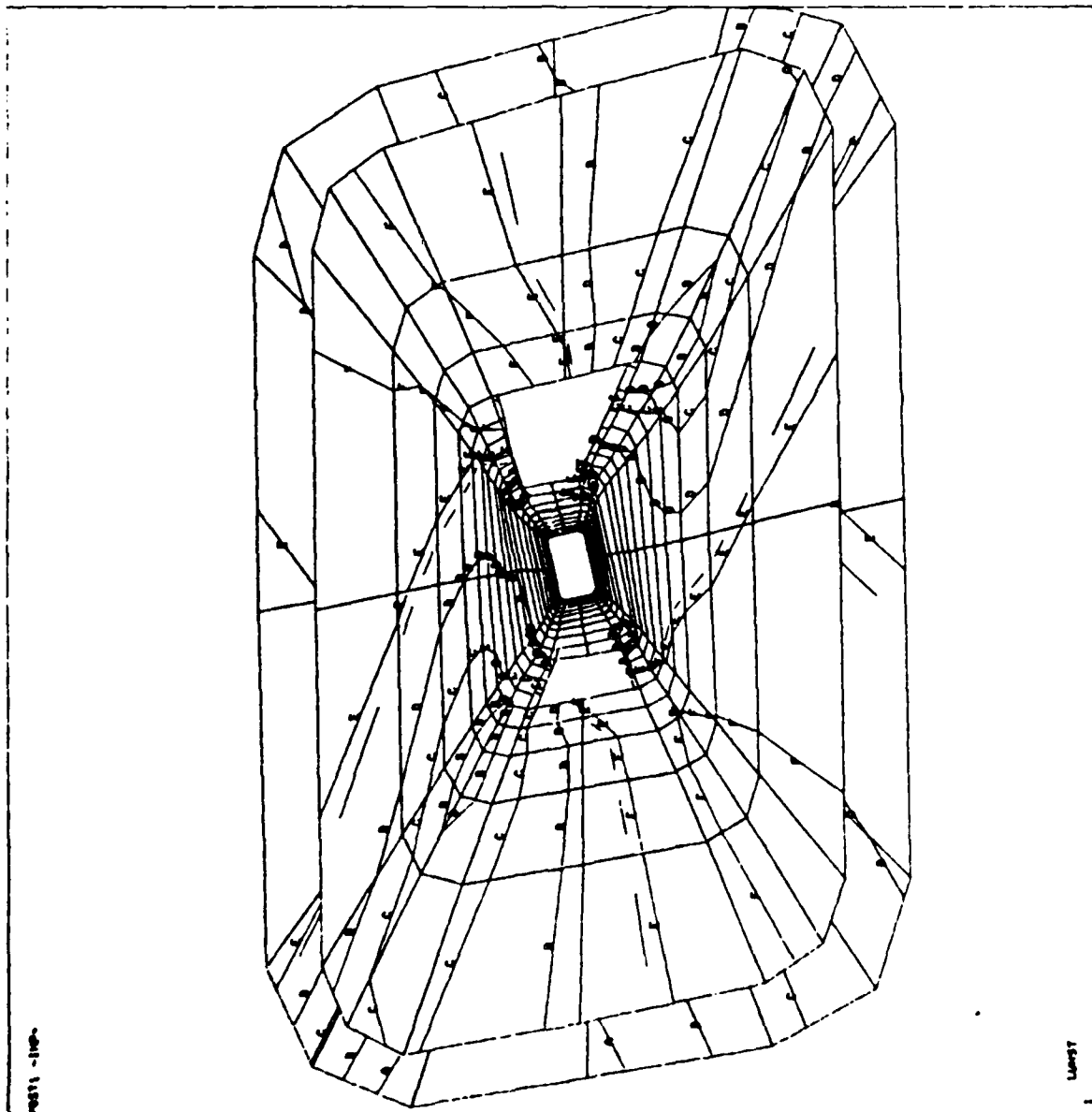
00555 4.28
MOU 85 1066
11 55:40
P0571 578550
STEP=1
17ER=1
S=11
MU=1
VO=1
20=1
D15T=104
27=116
M100M
PU=8493
MO=-5691
A=4446
B=-3489
C=-2132
B=-975
E=182
F=1329



ANALYSIS 4.20
 MOD 25 1006
 11.591.30
 POST1 STRESS
 STEP=1
 ITER=1
 SALL
 RV=1
 VU=1
 ZU=1
 DIST=104
 ZF=116
 M1000N
 PR=1002
 PR=7006
 A=5772
 B=4478
 C=3184
 D=1890
 E=500
 F=000



AUGUS 4.20
 NOV 25 1966
 1211140
 POST1 STRESS
 STEP=1
 ITER=1
 SV11
 DV=1
 0137-134
 DV=110
 CMC=40
 M100EN
 MA=2403
 MU=4601
 A=4406
 B=3009
 C=8132
 D=075
 E=102
 F=1370

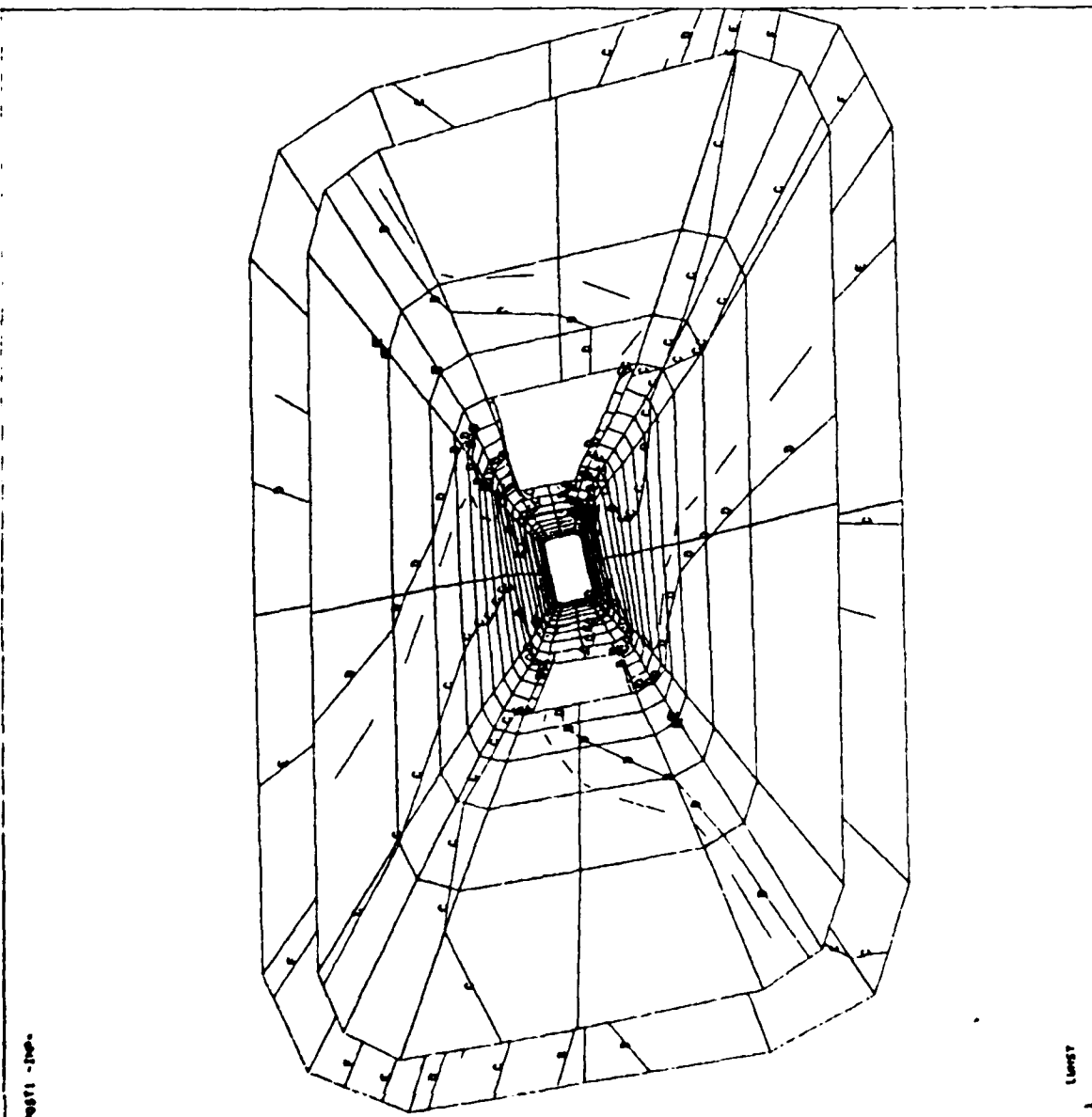


POST1-1100

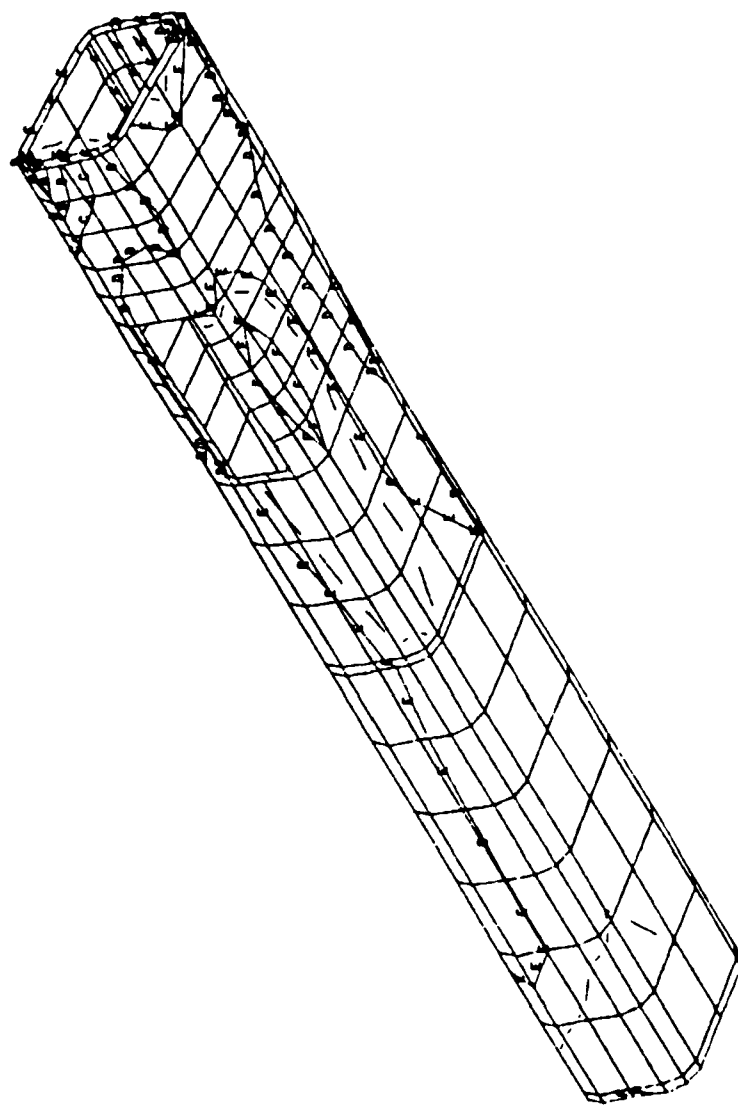
1100ST

1

ANSYS 4.20
 MOD 25 1986
 12:05:10
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 STEP=1
 ITER=1
 SALL
 ZU=1
 DIST=134
 ZP=110
 CONE=40
 HIDDEN
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 ANI=55540
 A=-40641
 B=25733
 C=-10826
 D=4003
 E=18091
 F=23090



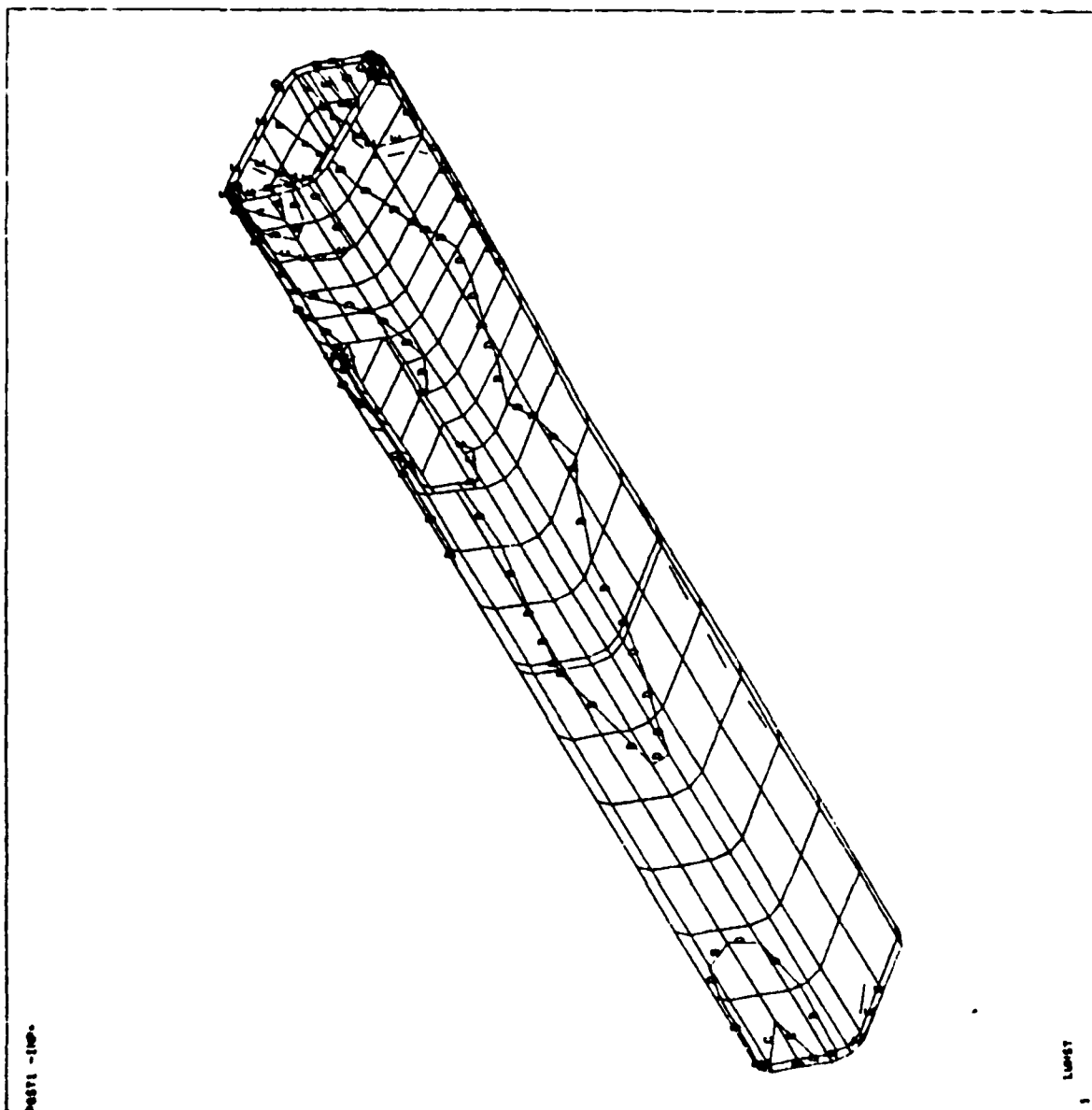
40193 4.28
 NOV 25 1966
 11-46-10
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 ITER=1
 SK12
 MU=1
 VU=1
 ZU=1
 D117=104
 ZF=110
 MIDEN
 ME=30-06
 PE=33129
 A=75476
 B=57012
 C=40152
 D=22422
 E=4832
 F=12226



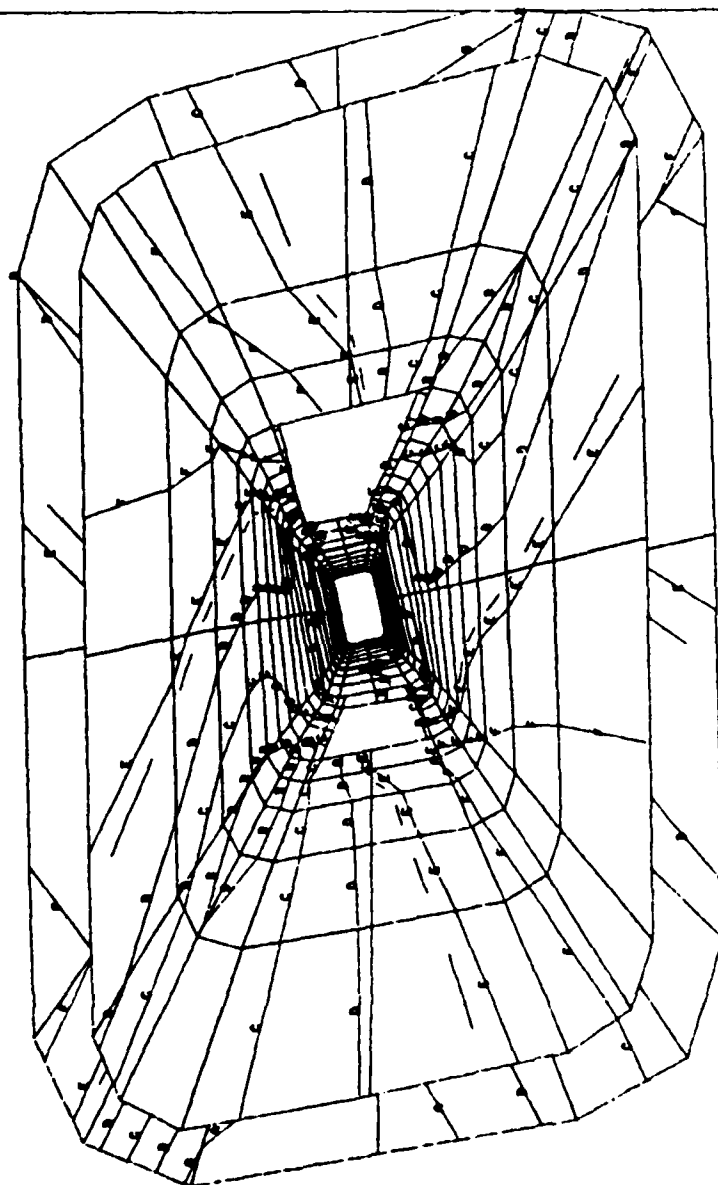
POST1 - 100 -

10007

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 9917 30 66666
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 9919 28 88888
 9920 27 99999
 9921 26 00000
 9922 25 11111
 9923 24 22222
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 9926 21 55555
 9927 20 66666
 9928 19 77777
 9929 18 88888
 9930 17 99999
 9931 16 00000
 9932 15 11111
 9933 14 22222
 9934 13 33333
 9935 12 44444
 9936 11 55555
 9937 10 66666
 9938 09 77777
 9939 08 88888
 9940 07 99999
 9941 06 00000
 9942 05 11111
 9943 04 22222
 9944 03 33333
 9945 02 44444
 9946 01 55555
 9947 00 66666
 9948 99 77777
 9949 98 88888
 9950 97 99999
 9951 96 00000
 9952 95 11111
 9953 94 22222
 9954 93 33333
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 9956 91 55555
 9957 90 66666
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 9959 88 88888
 9960 87 99999
 9961 86 00000
 9962 85 11111
 9963 84 22222
 9964 83 33333
 9965 82 44444
 9966 81 55555
 9967 80 66666
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 9969 78 88888
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 9973 74 22222
 9974 73 33333
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 9976 71 55555
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 9983 64 22222
 9984 63 33333
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 9988 59 77777
 9989 58 88888
 9990 57 99999
 9991 56 00000
 9992 55 11111
 9993 54 22222
 9994 53 33333
 9995 52 44444
 9996 51 55555
 9997 50 66666
 9998 49 77777
 9999 48 88888
 10000 47 99999
 10001 46 00000
 10002 45 11111
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 10023 24 22222
 10024 23 33333
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 10037 10 66666
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 10044 03 33333
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 10094 53 33333
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 10096 51 55555
 10097 50 66666
 10098 49 77777
 10099 48 88888
 10100 47 99999
 10101 46 00000
 10102 45 11111
 10103 44 22222
 10104 43 33333
 10105 42 44444
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 10109 38 88888
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 10111 36 00000
 10112 35 11111
 10113 34 22222
 10114 33 33333
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 10119 28 88888
 10120 27 99999
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 10128 19 77777
 10129 18 88888



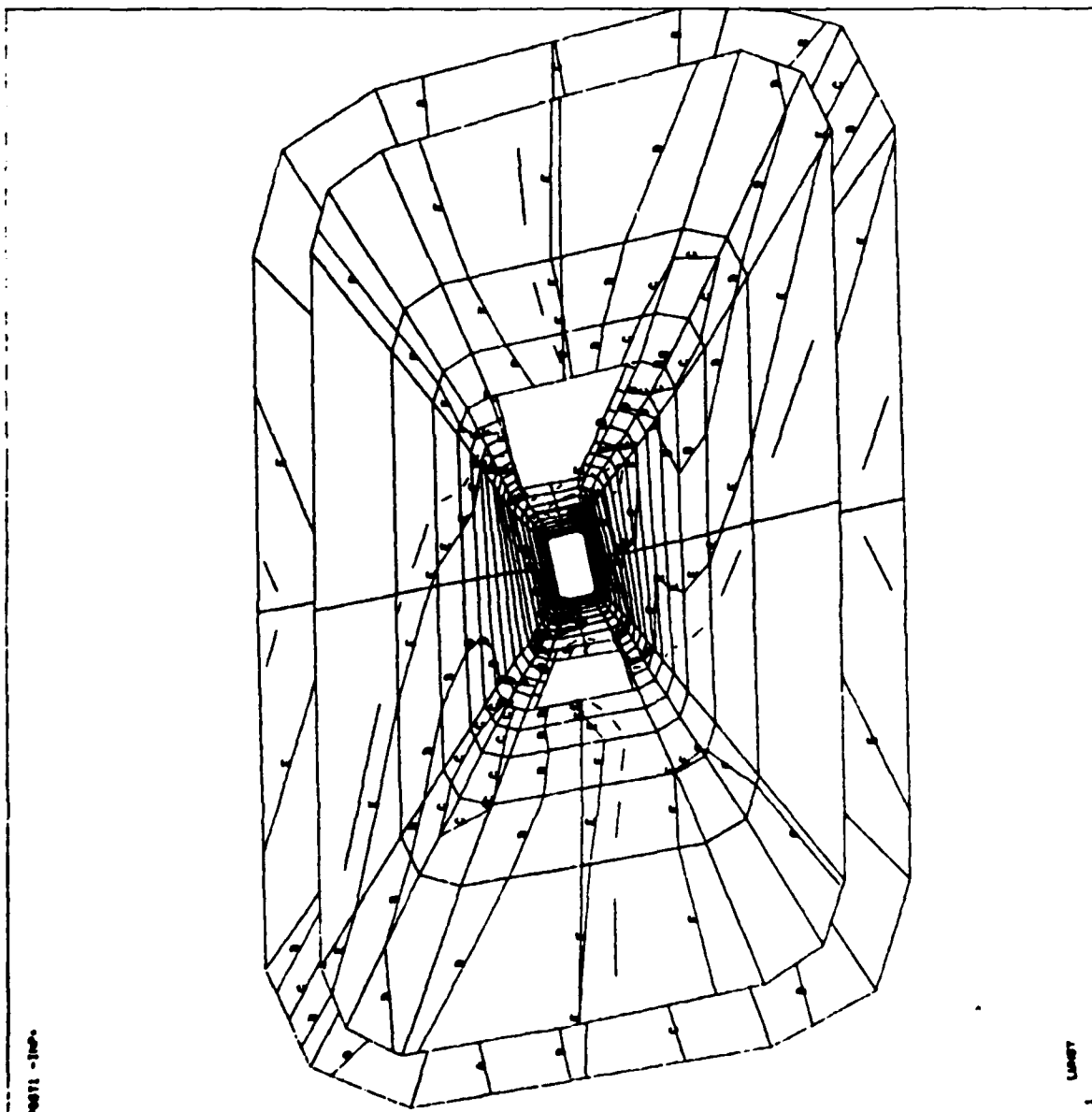
100-110



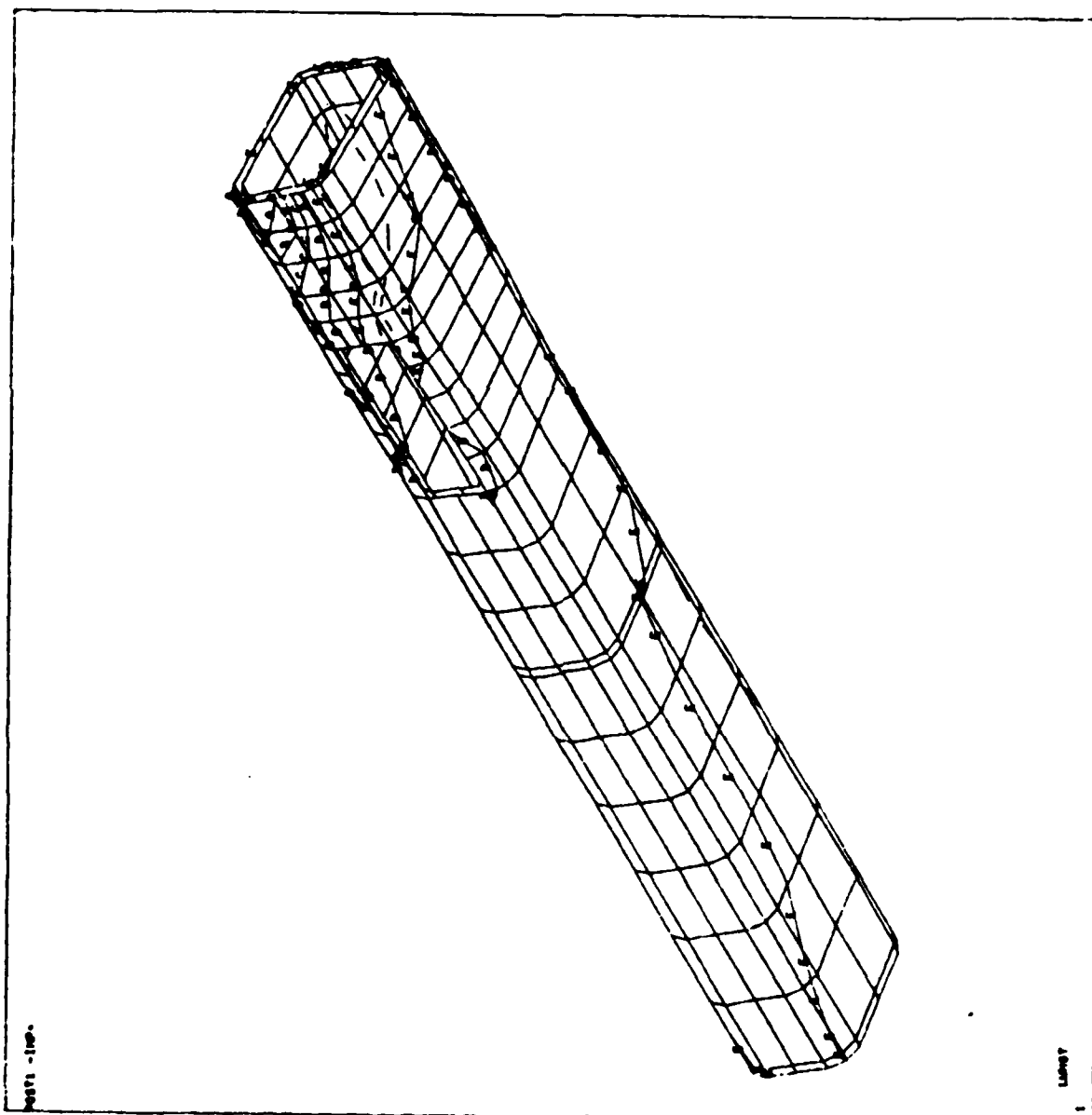
15087

00095 4.20
MAY 25 1966
12:00:00
P0871 STWSS
STG-1
VZB-1
SLE

20.1
0157:134
27.116
COM-40
HIGH
RM-20400
RM--07189
0--77672
0--57912
C--40154
0--20400
C--4026
F.1000

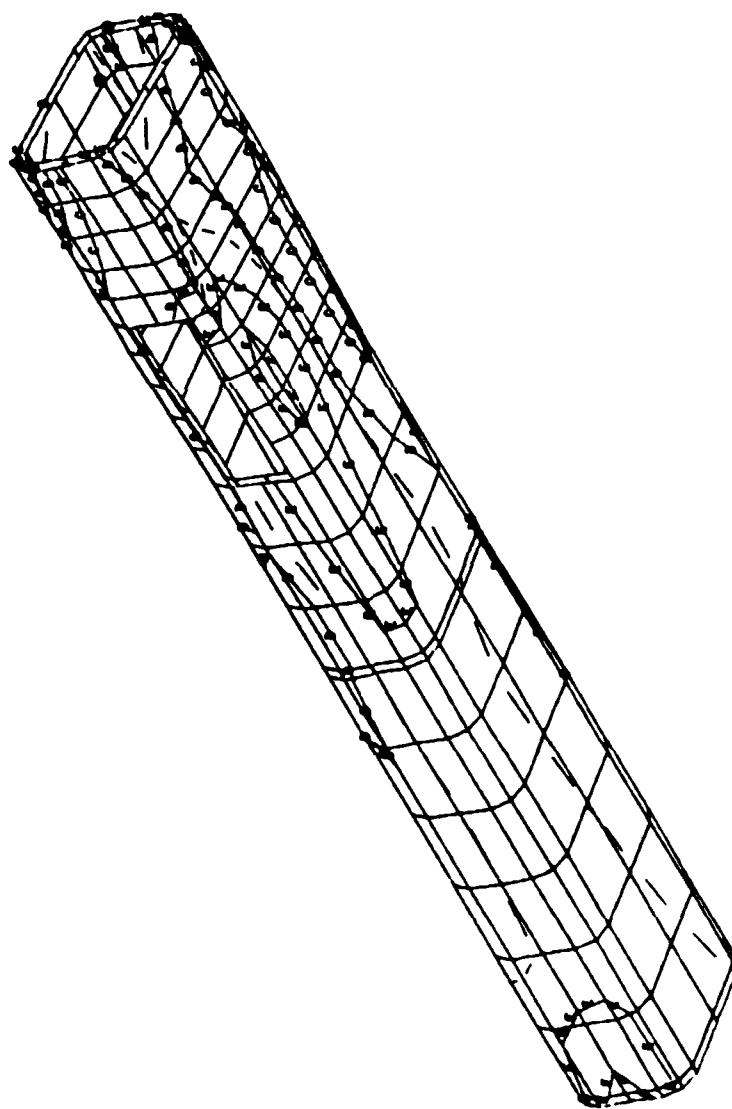


000000 4.20
 0000 75 1005
 111-00113
 000071 070050
 0700-1
 1700-1
 00113
 000-1
 000-1
 200-1
 0100-1004
 20-110
 0100004
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 000-1-00204
 00-110000
 00-010002
 00-040100
 00-77010
 00-00010
 00-110102



714

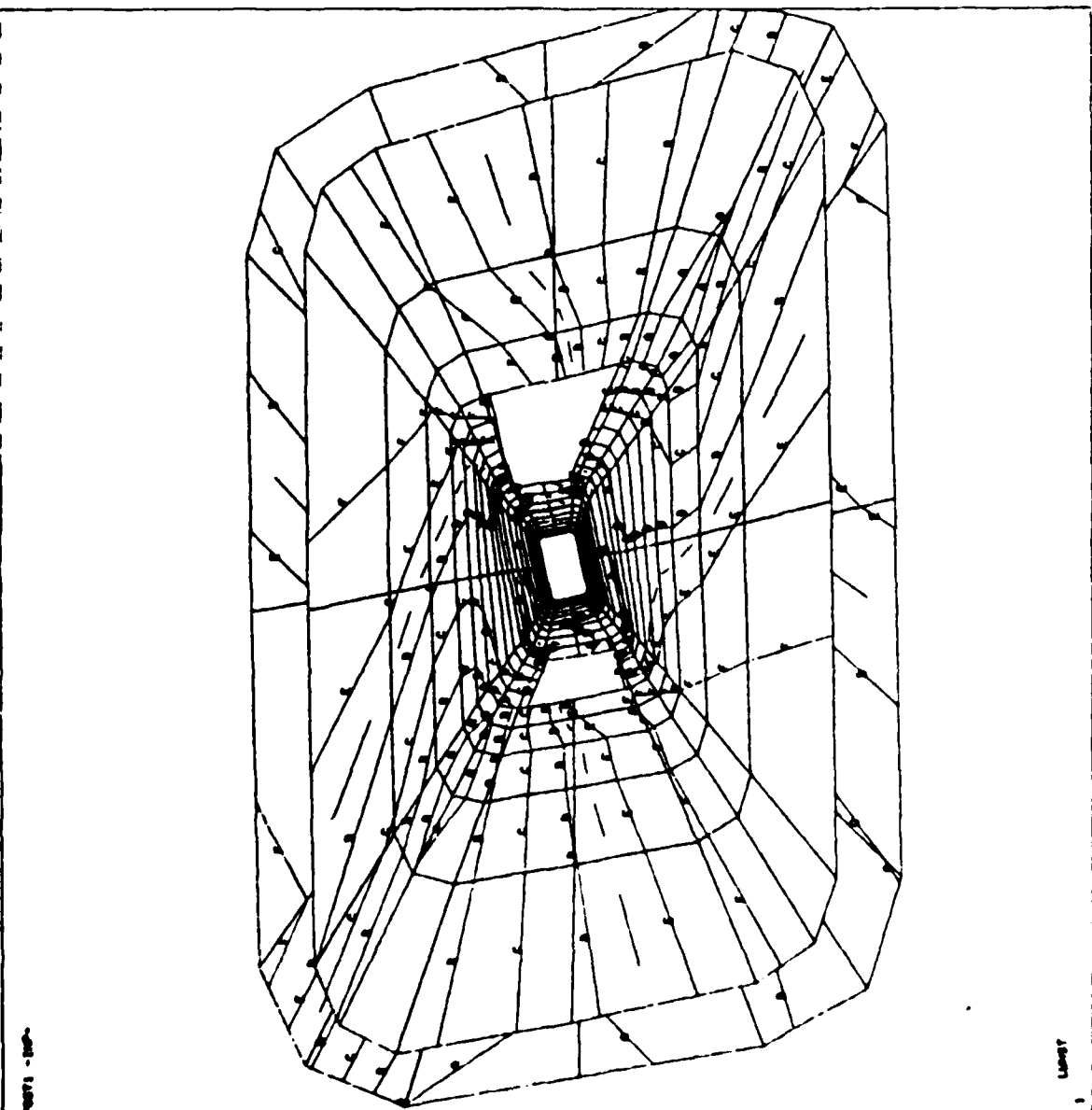
ADPVS 4.28
ADU 26 1800
10.00105
P0071 STVE10
STVE-1
1720-1
0413
300--1
400--1
200-1
0101-104
27-110
010000
00-2405
000-0007
00-2103
00-2100
00-1003
00-210
00-017
F-1000



P0071 - 1000

10007

DATE 4.20
NOV 05 1965
131101-00
PAGE 11 SYM 10
STEP-1
VIEW-1
SY 13
20-1
0107-134
20-116
CODE-02
4100214
RM-2100
PM-2702
A--2002
B--2100
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D--400
E-024
F-1000



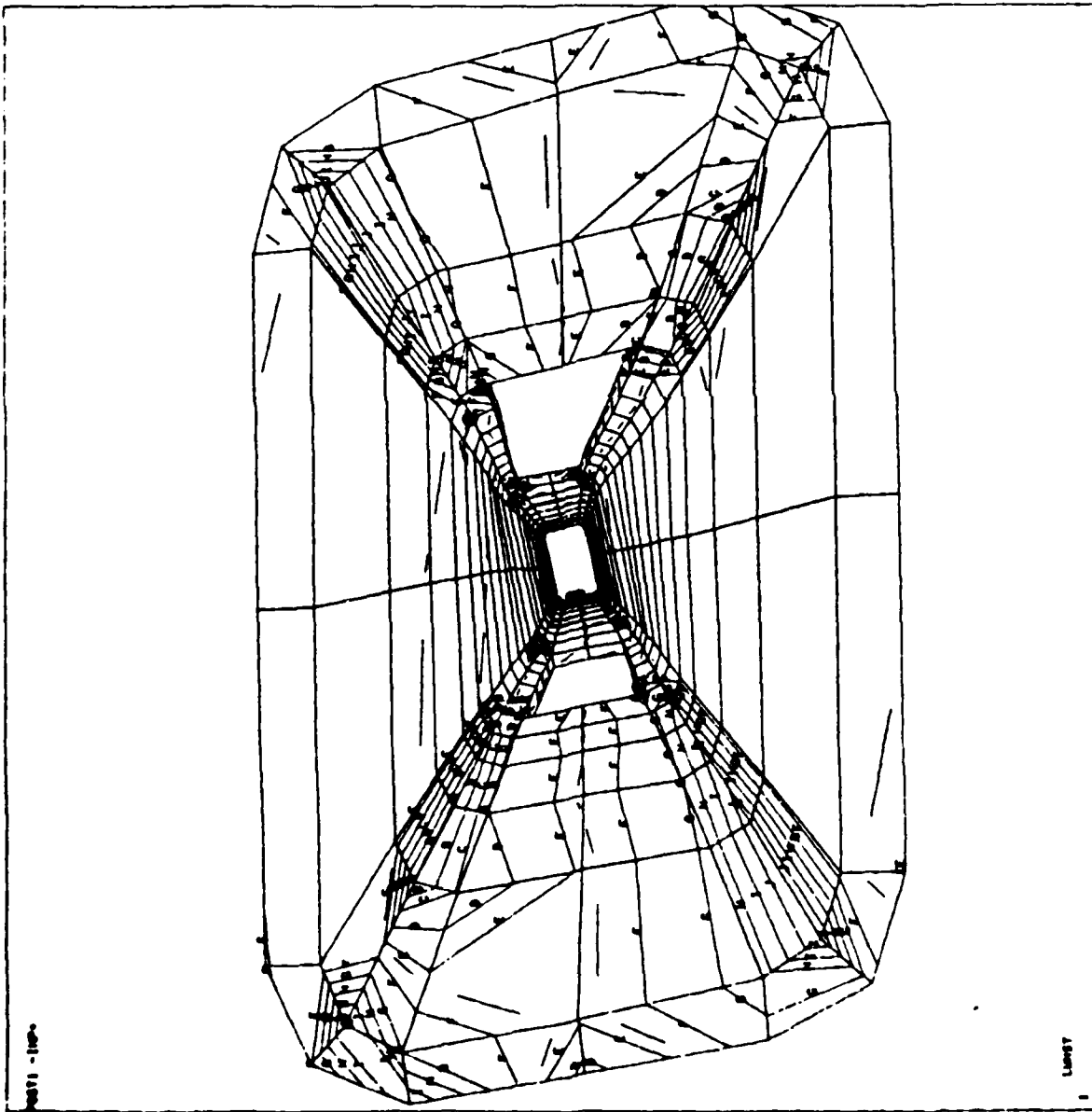
131101-00

131101

A complex 3D wireframe diagram of a hexagonal structure, possibly a crystal lattice or a mechanical component. The structure is composed of numerous interconnected lines forming a hexagonal prism-like shape with internal features. The diagram is oriented vertically, with the hexagonal faces at the top and bottom. The internal structure shows a series of parallel lines converging towards a central point, creating a sense of depth and perspective. The overall appearance is that of a technical drawing or a mathematical model of a geometric object.

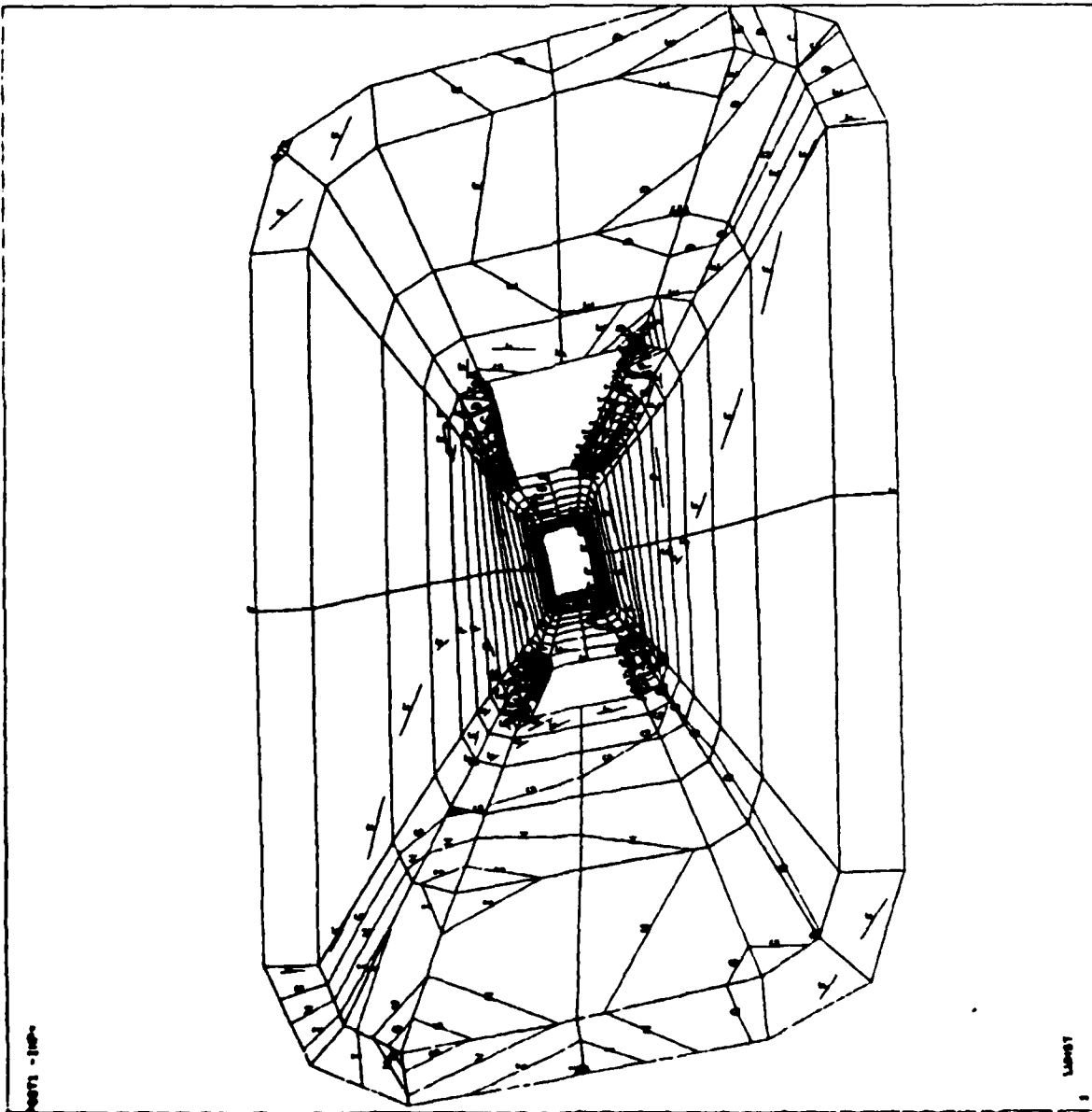
74 (1)

00000 4.00
 000 20 1000
 10:30:00
 POST1 STRUC6
 STEP=1
 ITER=1
 SU
 BOTTOM
 STRESS ELIN 60
 20=1
 0187-136
 2F-116
 C000-45
 MID000
 000-234
 000-210
 A--002
 B--002
 C--148
 D--01.7
 E--01.7
 F--00.3
 G--00.3
 H--100
 I--210
 J--270



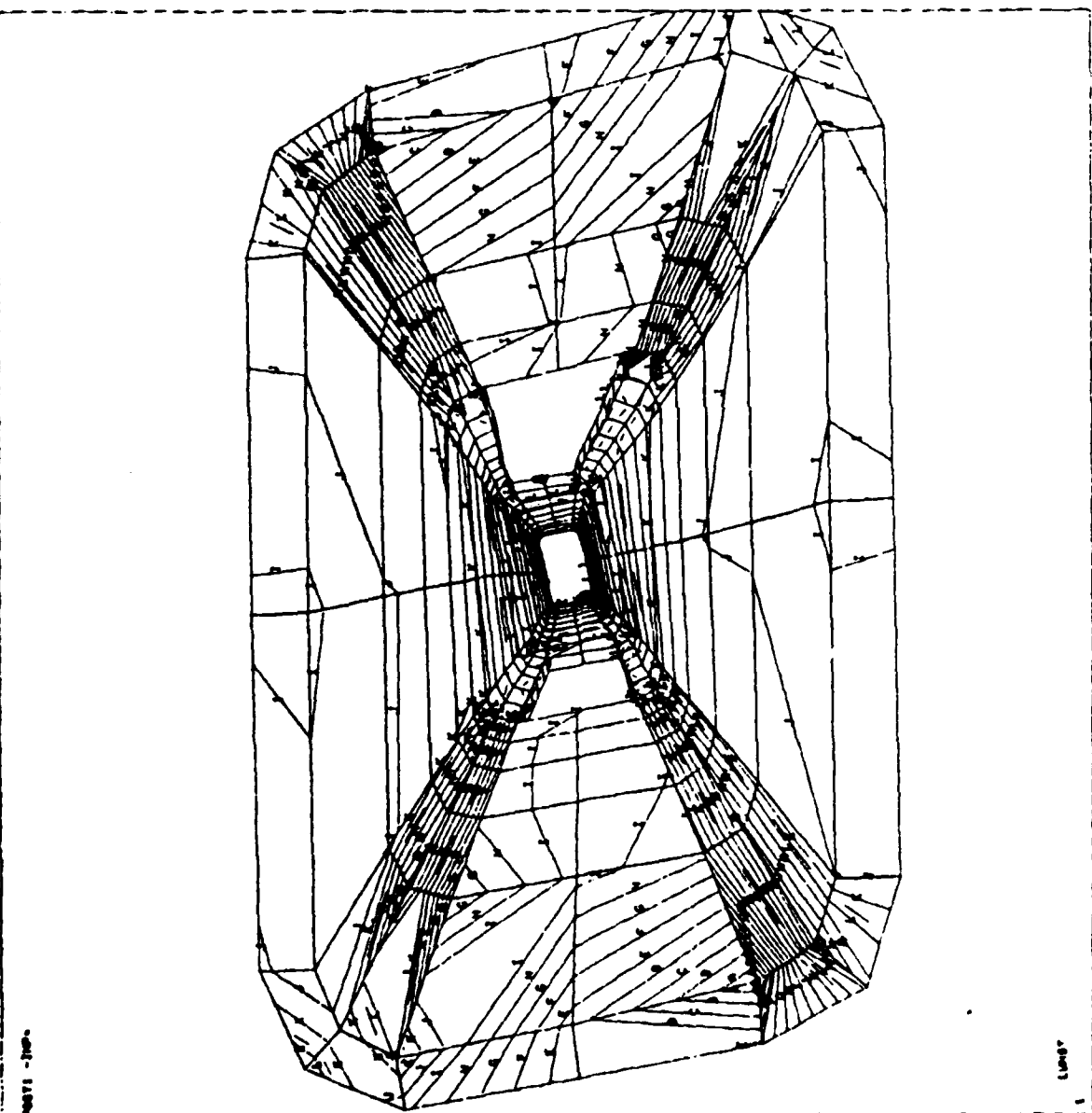
CORE

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 15124112
 P0071 STRE60
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 ITER=1
 SOL2
 SOL1000
 STRESS ELER 60
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 0107=1.25
 27=110
 CONE=40
 0100EN
 00=107
 00=120
 0=111
 0=00.4
 0=07.4
 0=06.4
 0=23.4
 0=1.44
 0=20.0
 0=42.0
 1=64.0
 3=00.0



CORE
 76

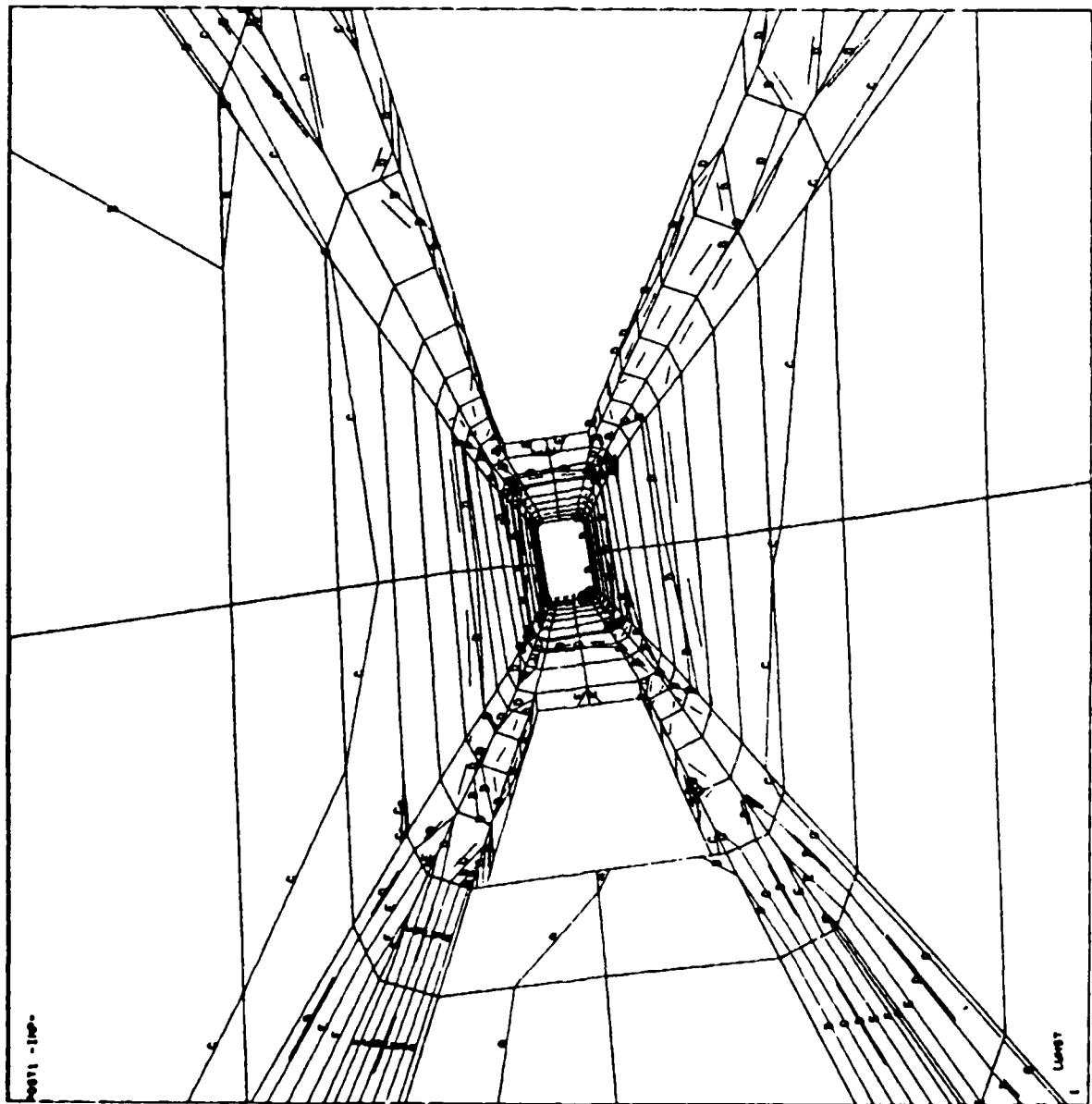
ANALYSIS 4.20
 NOV 25 1966
 15131010
 POST1 STRESS
 STEP=1
 ITER=1
 LAY
 BOTTOM
 STRESS ELER C8
 24-2
 D157-1.26
 25-116
 COME-0.46
 M1384
 M1-160
 M1-437
 A-406
 B-267
 C-289
 D-291
 E-263
 F-215
 G-177
 H-130
 I-101
 J-68.8
 K-24.8
 L-12.5
 M-61.5
 N-89.5
 O-187



CORE
 77

ANSYS 4.20
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 18:28:42
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 STEP=1
 ITER=1
 SAV
 BOTTOM
 STRESS ELER C5

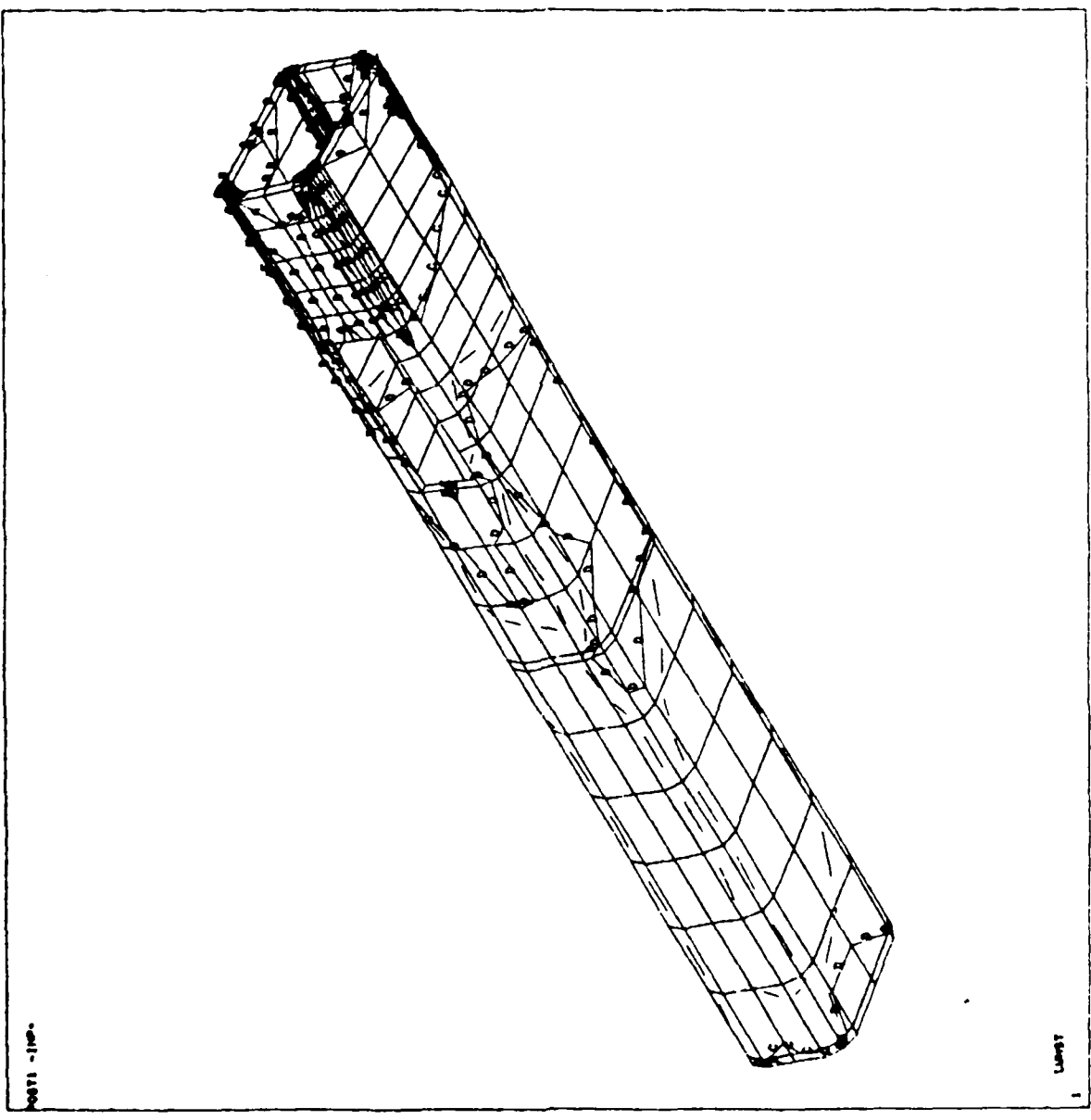
20=1
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 27-116
 CONE-46
 HIBDEN
 RM-120
 RM-172
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 B-84.9
 C-89.9
 D-5.00
 E-40.1
 F-75.1



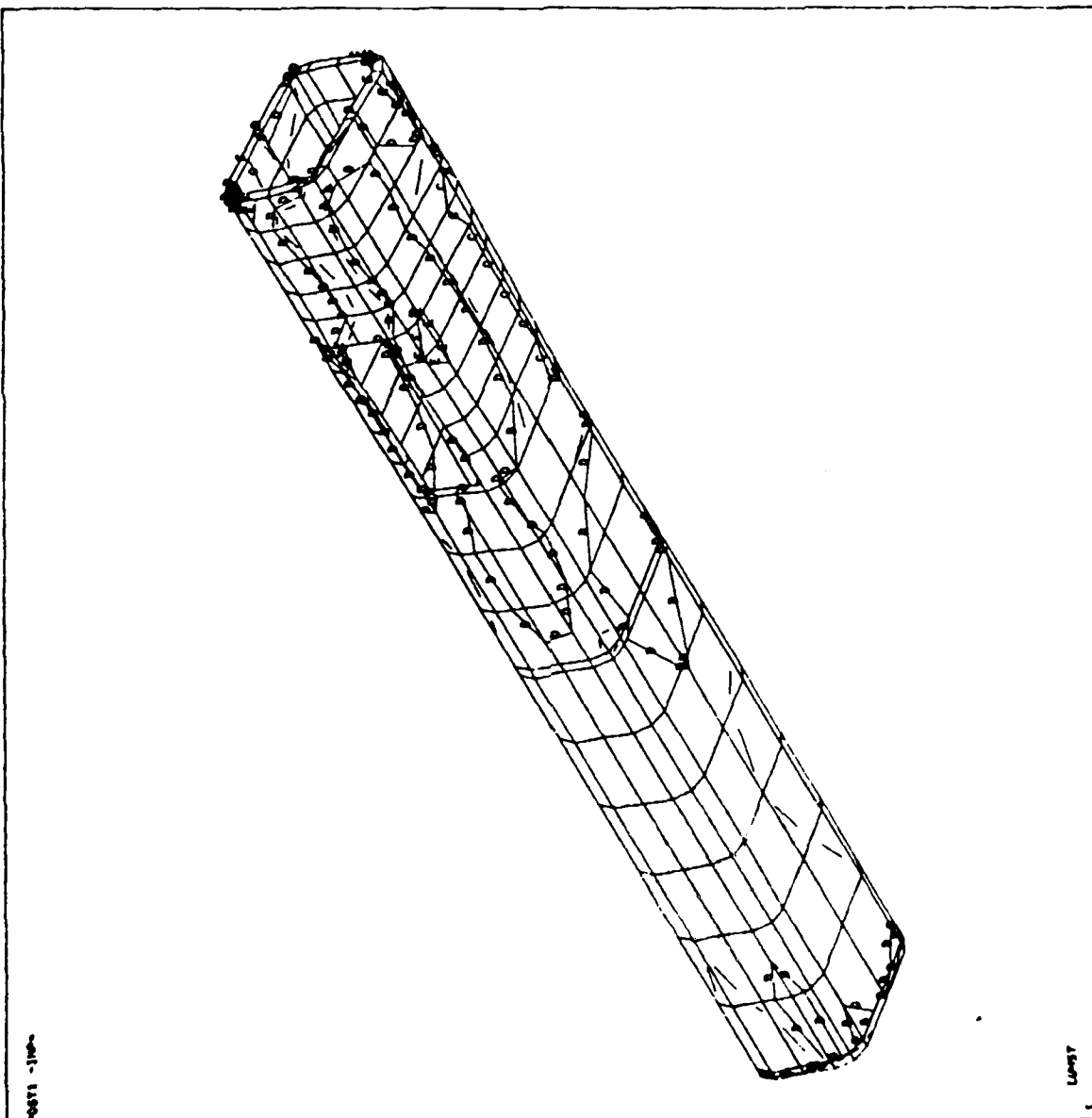
CORE
 78

CORE 78

ANSYS 4.20
 MOD 25 1986
 15120112
 POST1 STRESS
 STEP=1
 ITER=1
 DIV
 BOTTOM
 STRESS ELER C6
 20--1
 20--1
 20--1
 DIST=104
 27=110
 MIDDEN
 RM=160
 RM=437
 A=99.9
 B=94.0
 C=20.0
 D=5.00
 E=40.1
 F=75.1

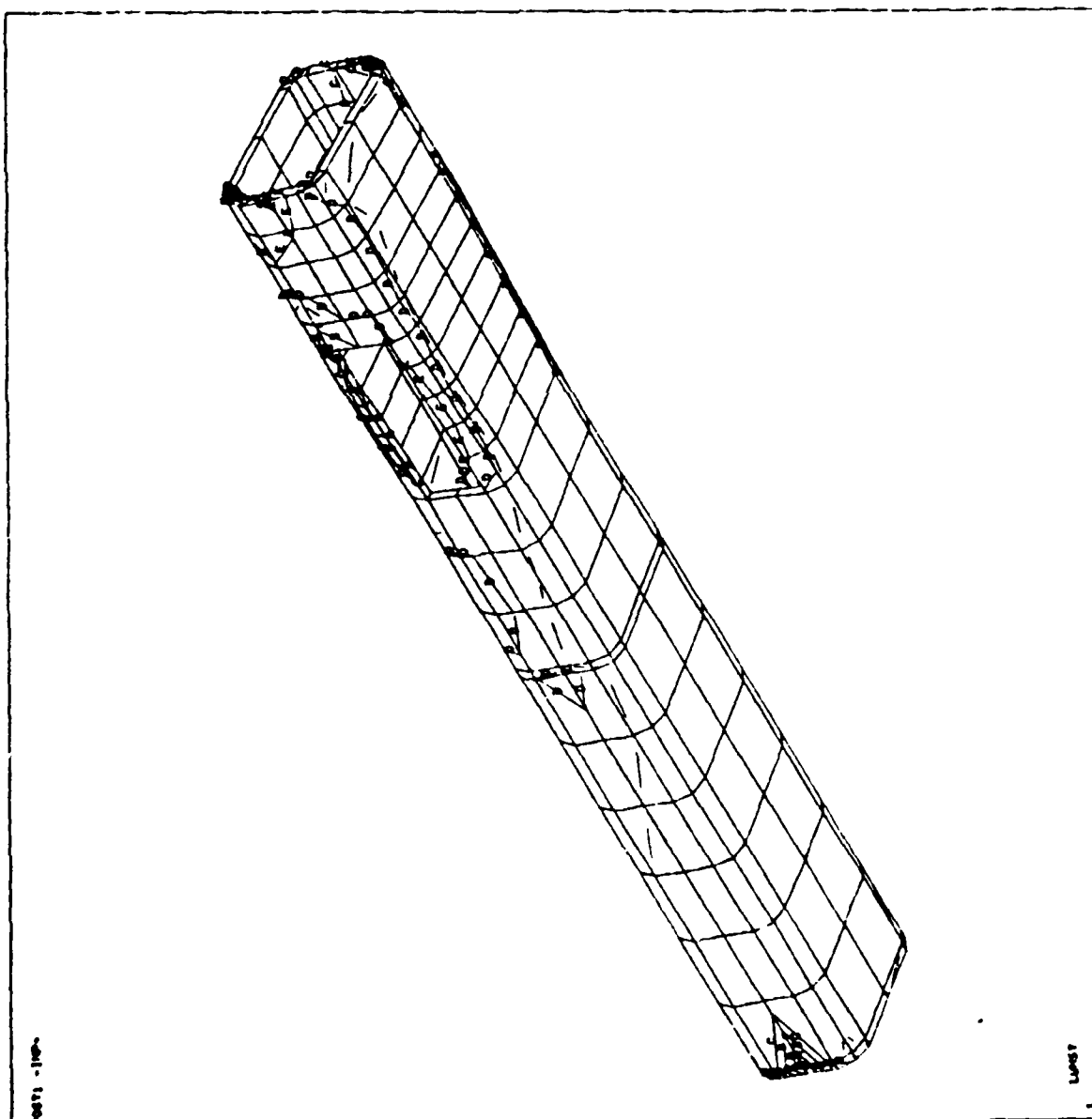


00154 4.20
 NOV 20 1966
 15:20:00
 POST1 STRESS
 STEP=1
 ITER=1
 242
 BOTTOM
 STRESS (LEW 55
 20--1
 VU--1
 20--1
 DIST=104
 27-116
 HIDDEN
 RH=76.5
 RM=82.8
 B--64.9
 C--29.9
 D--5.05
 E=40.1
 F=75.1



CORE

00000 4.00
 000 25 1200
 15:11:50
 POST1 STRESS
 STEP=1
 LAYER=1
 SIZE
 BOTTOM
 STRESS ELER C5
 NU=1
 VU=1
 ZU=1
 27-110
 2187-100
 MIDDER
 MU=107
 MU=132
 A=90.0
 B=64.0
 C=20.0
 D=5.00
 E=40.1
 F=75.1



core

D2/370

CEL MEMO: DECEMBER 8, 1986

Interoffice

To R. Rathe

From C. R. Ortloff

Subject **STATIC ANALYSIS RESULTS FOR THE LVHD
COMPOSITE CRADLE - PROF LOAD CONDITIONS**

Date Dec. 8, 1986

cc E. Thuse
L. Liebhardt (NOD)
J. Ries* (NOD)
A. Amberg
B. Ziervick (NOD)
E. Alexander (NOD)
R. Kazares

*one copy of original 61
figures only

82-143

Although the cradle design is to be modified again (Memo J. Ries to CRO, 5 Dec 86), it was recommended that the composite design analysis of the old design (drawings delivered, J. Ries to CRO, 14 Nov 86) and subsequent modification 20 Nov 86 be completed. If the latest cradle design shows stresses past allowable values and insufficient time remains to analyze it before it is sent out for prototype bid, then at least one existing prior cradle version has been analyzed with necessary modifications to make it meet design allowables. In this manner, a "back-up" design will exist as a fall-back position if required.

The present static analysis indicates that the 14 Nov 86 cradle design, allowing for a safety factor of 2X (or stress amplification of 2X resulting from the combined effects of moisture absorption, thermal expansion and dynamic amplification loads plus a nominal safety factor allowing for materials defects and manufacturing "built-in" defects) has serious defects in design and should be modified. The attached figure (Figure 1-A) recommends a modified design that should both reduce bending and torsional deflections as well as relieve the existing high stress levels to acceptable levels. If you wish, I can provide calculations to indicate the adequacy of the modified model.

For the new woven roving cradle design (5 Dec 86) it is strongly recommended that a static/dynamic analysis be performed to check the stress levels in each lamina. Use of "averaged equivalent" stresses using CMAP equivalent moduli are in error and local lamina stress allowables may be exceeded (displacements calculated in this manner, however, are reasonably accurate). CEL has wide experience with analysis, test and manufacturing techniques for woven roving materials and would be glad to assist you in your materials selection efforts if requested.

Attached are figures 82-143 showing the static stress state for the composite cradle. This output set updates that contained in the previous memo (CRO to J. Ries 25 Nov 86) as the present set incorporates zero bending stiffness connections between manifolds

3

(Case B). The prior run (Case A - Figures 1-81) contains a rigid connection (the barrel) between manifolds that effectively stiffened the front part of the cradle to bending. Case B results also incorporate the sliding 2nd manifold; additionally, all of the recoil force is on the front manifold. For Case A and B, the firing torque load is distributed equally between 1st and 2nd manifolds. As bending stiffness is less between manifolds for Case B than for Case A, it is expected that vertical deflections will exceed those of Case A and stresses will be higher in the front part of the cradle. A summary of results is given below for Case B:

- o Maximum in-plane lamina shear stress (SHL) for the entire cradle is less than 6,000 psi (layer 1 for example). Allowed stress is 10,000 psi. Allowing for a 2X factor due to thermal expansion effects, moisture swelling induced stress, stress concentrations due to local defects and assuming a dynamic stress amplification factor greater than unity (or a safety factor of 2X for stress), SXY failure may be anticipated in layers 1, 2, 4, 5, 8, 9, 11). This result is similar to the Case A result.
- o Maximum interlaminar shear is less than 100 psi throughout. This result is similar to the Case A result. No failure is anticipated in this mode.
- o Maximum vertical deflection is now about 5 inches (figure 82). This exceeds the Case A deflection (about 4 inches). This is expected as the longitudinal bending stiffness is less for Case B than A. Deflection between manifolds is about 3.5 inches (UY). Results from the dynamic amplification analysis will determine the relative dynamic bending deflections between manifolds. Since the static deflection is already high, some stiffening members may need to be added between manifolds to limit relative deflection to prevent gun to rail binding.
- o Maximum ROTZ rotation is about 3.5° (as before for Case A). This is due to the application of similar torque loads to each manifold as before. The Case A beam connection between manifolds (the barrel) does not have torsional stiffness.
- o Maximum fiber stress (SXL) is about 120 ksi in the region near the gimbal attachment zone (figure 118, 121, 139) on the cradle. Allowing for a 2X safety factor, the stress value exceeds the maximum allowed stress of 180 ksi.

not relevant

R. Rathe
Static Analysis Results for the LWHD
Composite Cradle - Proof Load conditions

Dec. 8, 1986
Page 2

- o Epoxy stresses (SYL) are on the order of 4,000-5,000 psi (figures 99, 103, 106, 128, 131, 134). Allowing for a 2X safety factor, the stress exceeds the failure stress of 6 ksi. This is the major cause for concern in the present design as internal resin cracks may be formed serving as failure centers to redistribute loads to the already highly stressed fibers.
- o Foam core normal (figure 142) and shear stress (figure 143) appear to be less than 100 psi in areas away from the gimbal mounting zones. A suitable core material with failure properties above these limits can easily be found.

Although Cases A and B indicate failure of the existing design, this can be remedied by additional layers of Gr/Ep added in a different stacking sequence. This new sequence is shown in Figure 1A and should result in less vertical and rotational deflection as well as lowering stress values to allowable levels. The additional layers are on the rear part of the cradle only and can be easily included in the winding sequence.

I am forwarding originals of all graphs so you will have the clearest copy. These should be stored in a cool, dark place to preserve them. At some later time when a final stress report is required, I will ask for the return of this material to prepare this report.



C. R. Ortloff

4.1

NEW SEQUENCE

$$[0/45/-45/90/-45/45/0]_s$$

ON EACH SIDE OF CORNER

OLD SEQUENCE:

$$\{0/+45/-45/90/-45/+45/0/$$
$$0/+45/-45/90/-45/+45/0]$$

ON EACH SIDE OF CORE

62/69

NEW SEQUENCE

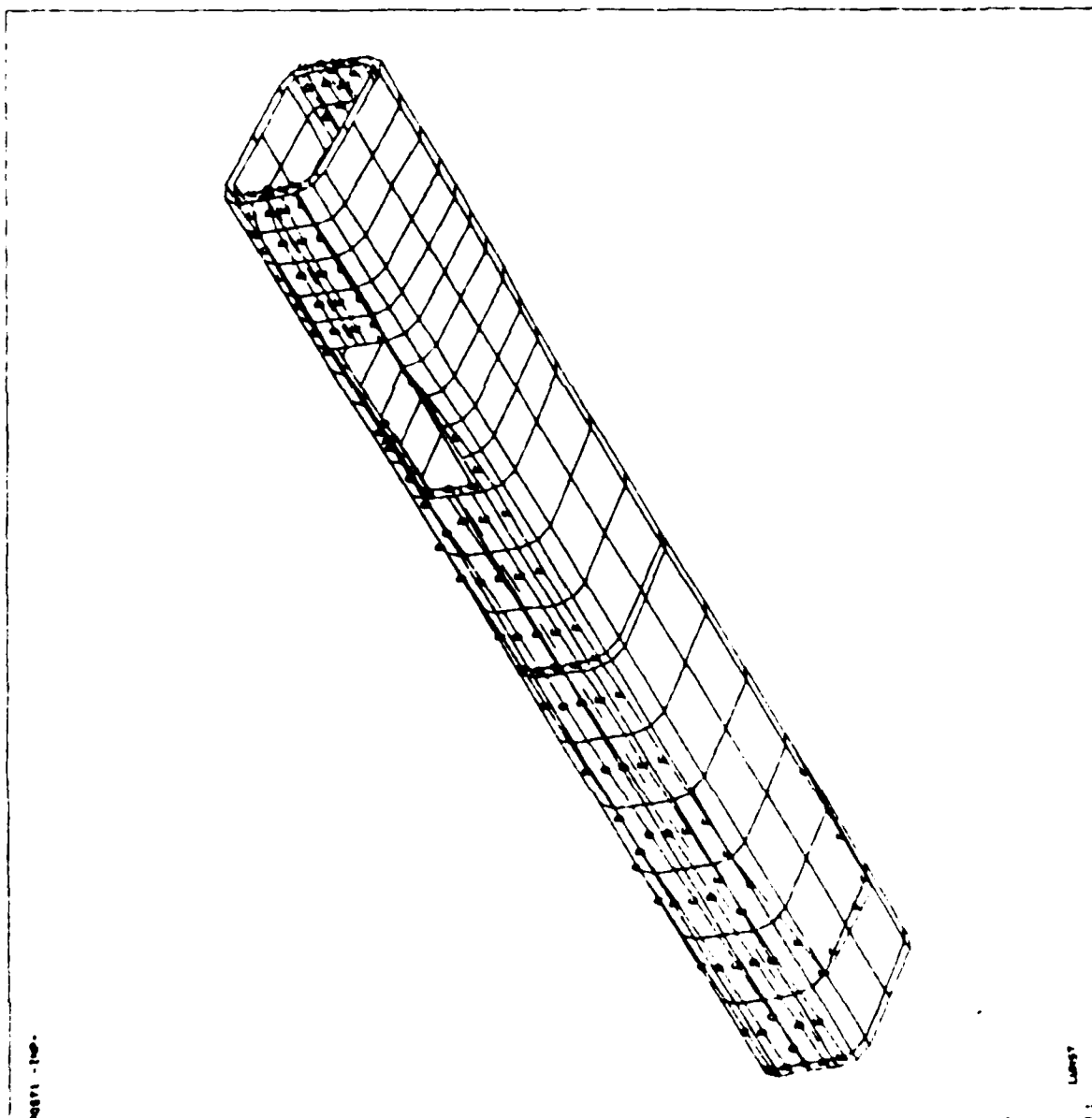
$$[0_3/45_2/-45_2/90_2/-45_2/45_2/0_3]$$

ON EACH SIDE OF CORE -
EXTENDS FROM GIMBAL
REGION TO 2ND MANIFOLD -
LAYERS FAIRED INTO FRONT
SECTION SMOOTHLY

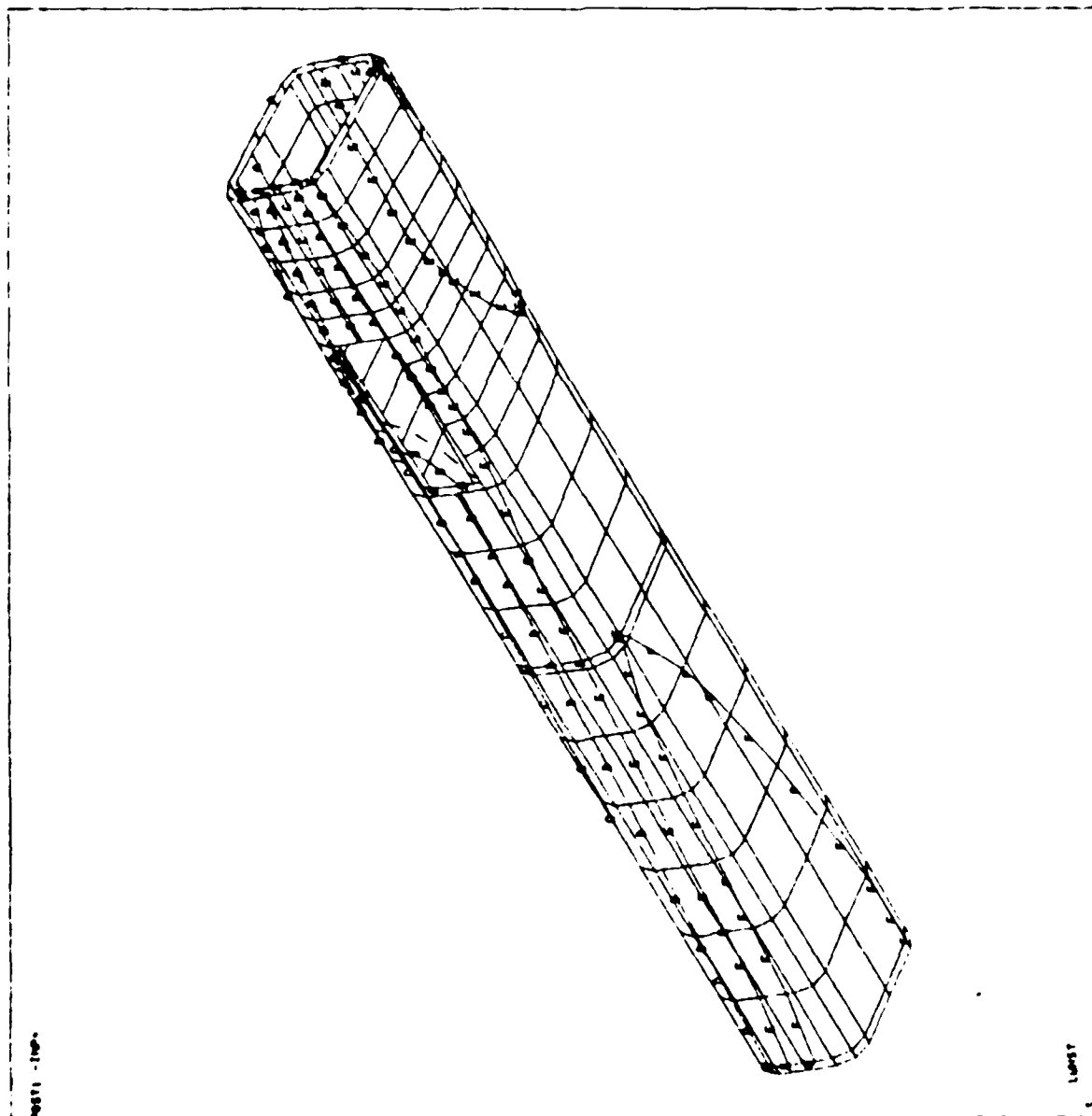
ALTERNATE CRADLE-
DESIGN TO ACHIEVE
DESIGN ALLOWABLES

FIGURE 1A

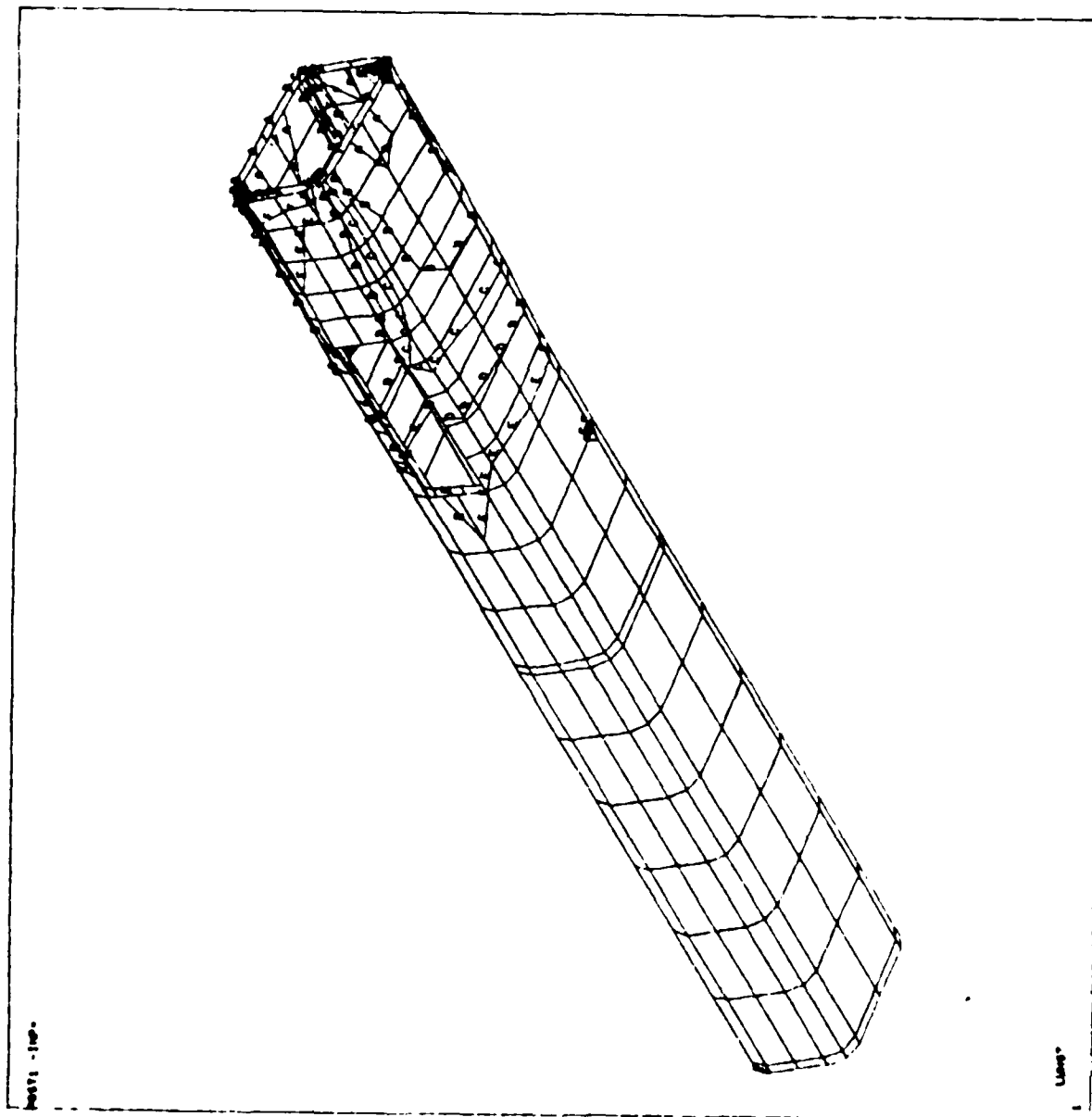
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C=1.02
B=1.12
C=1.10
F=1.00



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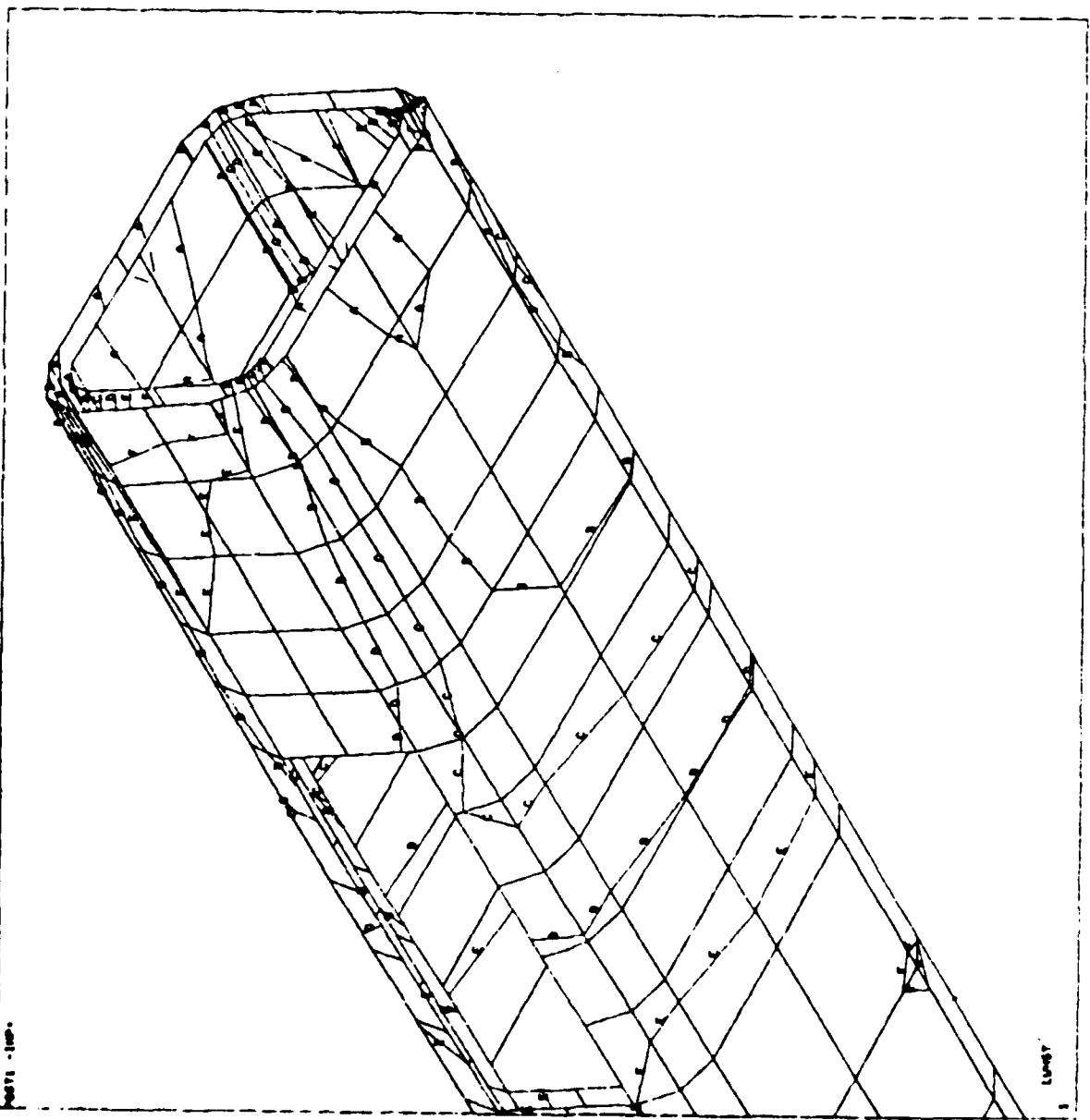
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C-0207
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E-0647
F-0707



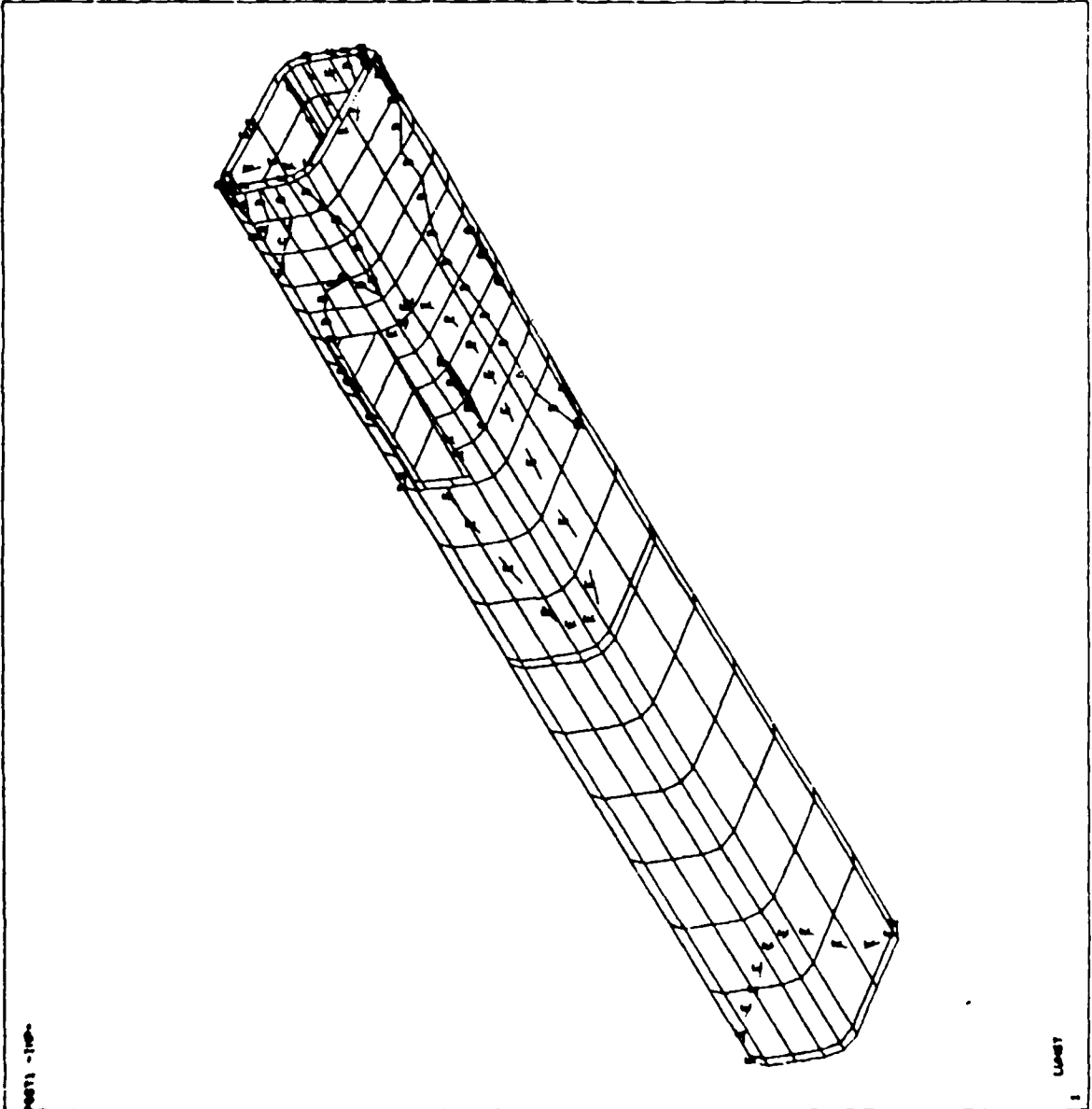

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B 17-36.0
B 17-18.0
B 27-105
V170-1.05
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C-0307
D-0507
E-0647
F-0787

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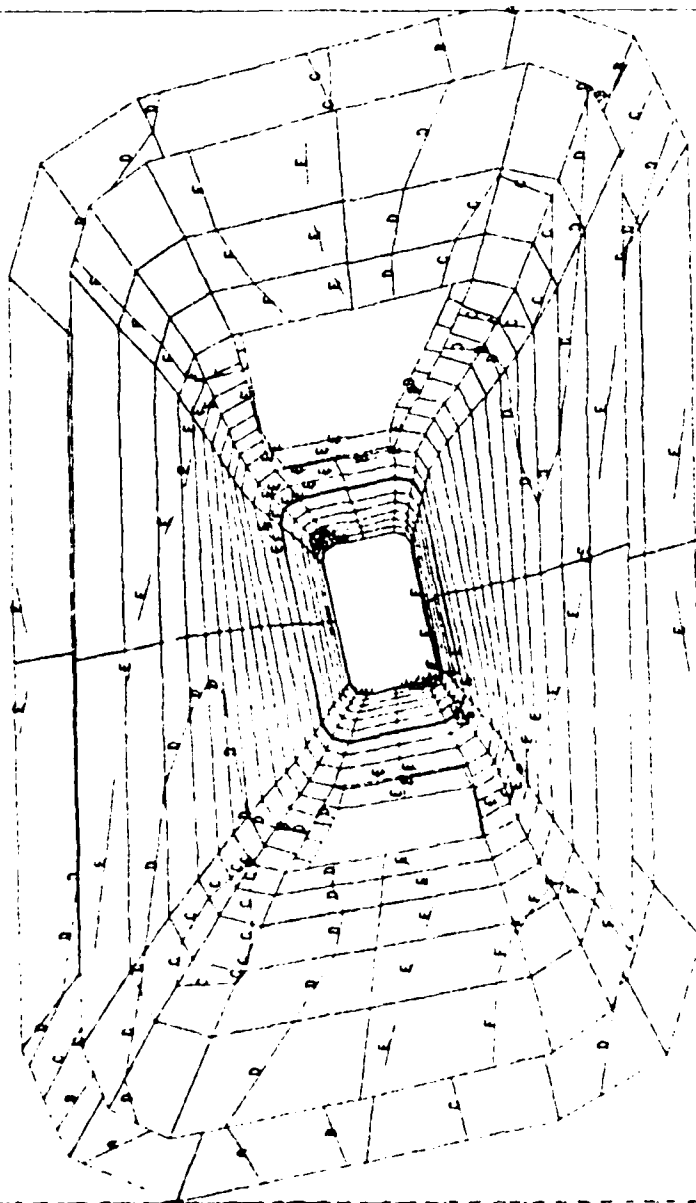


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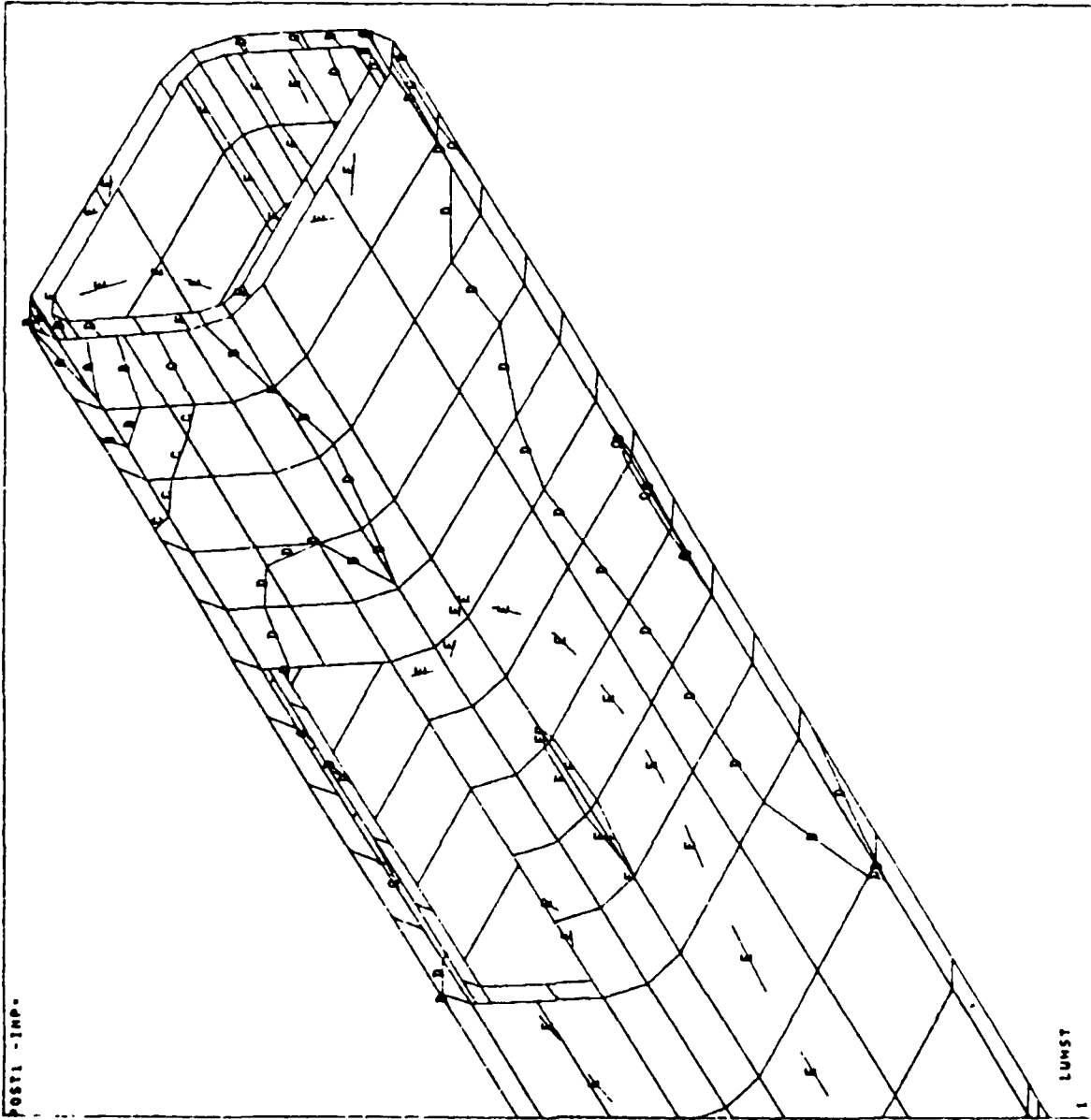
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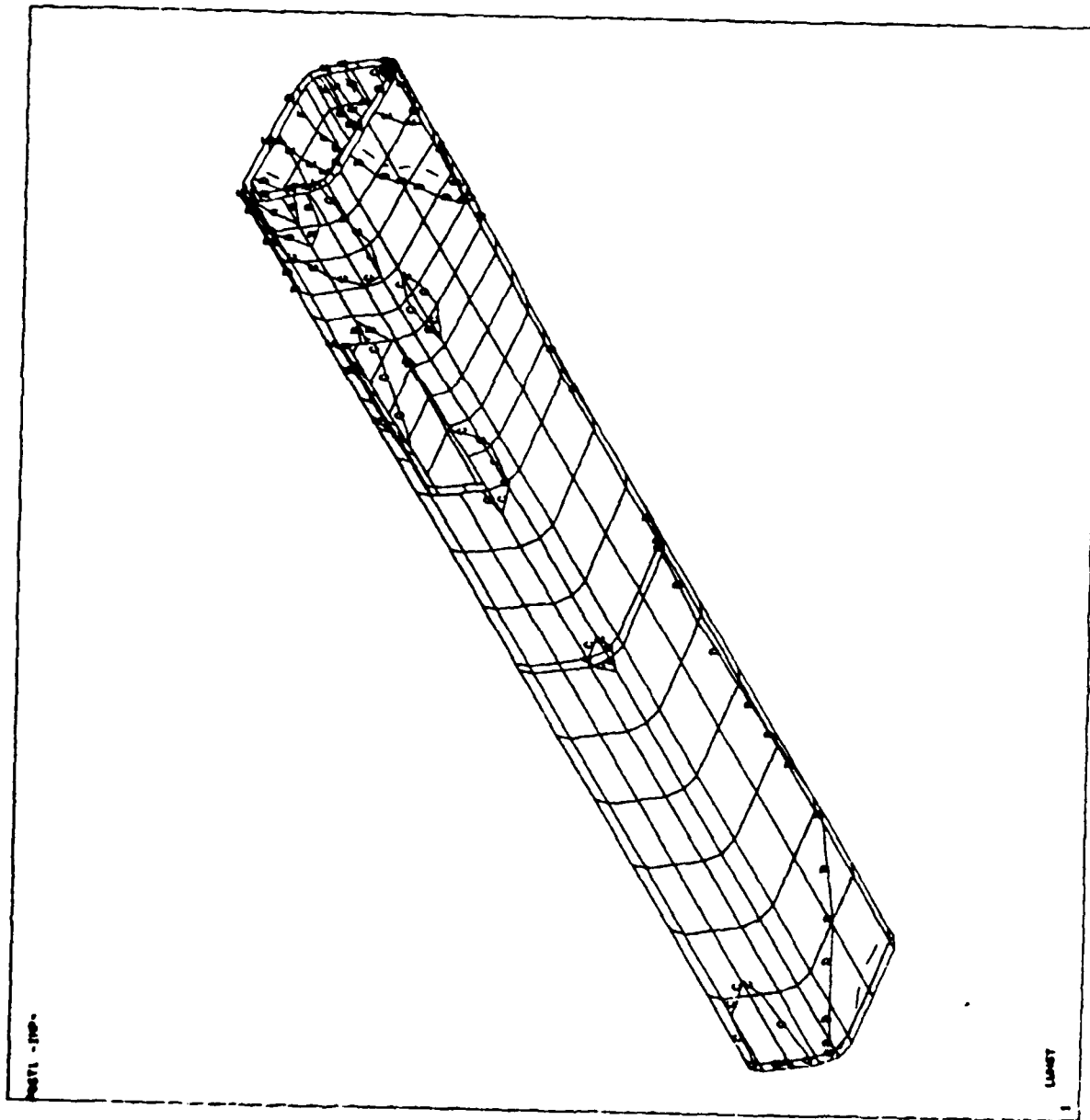
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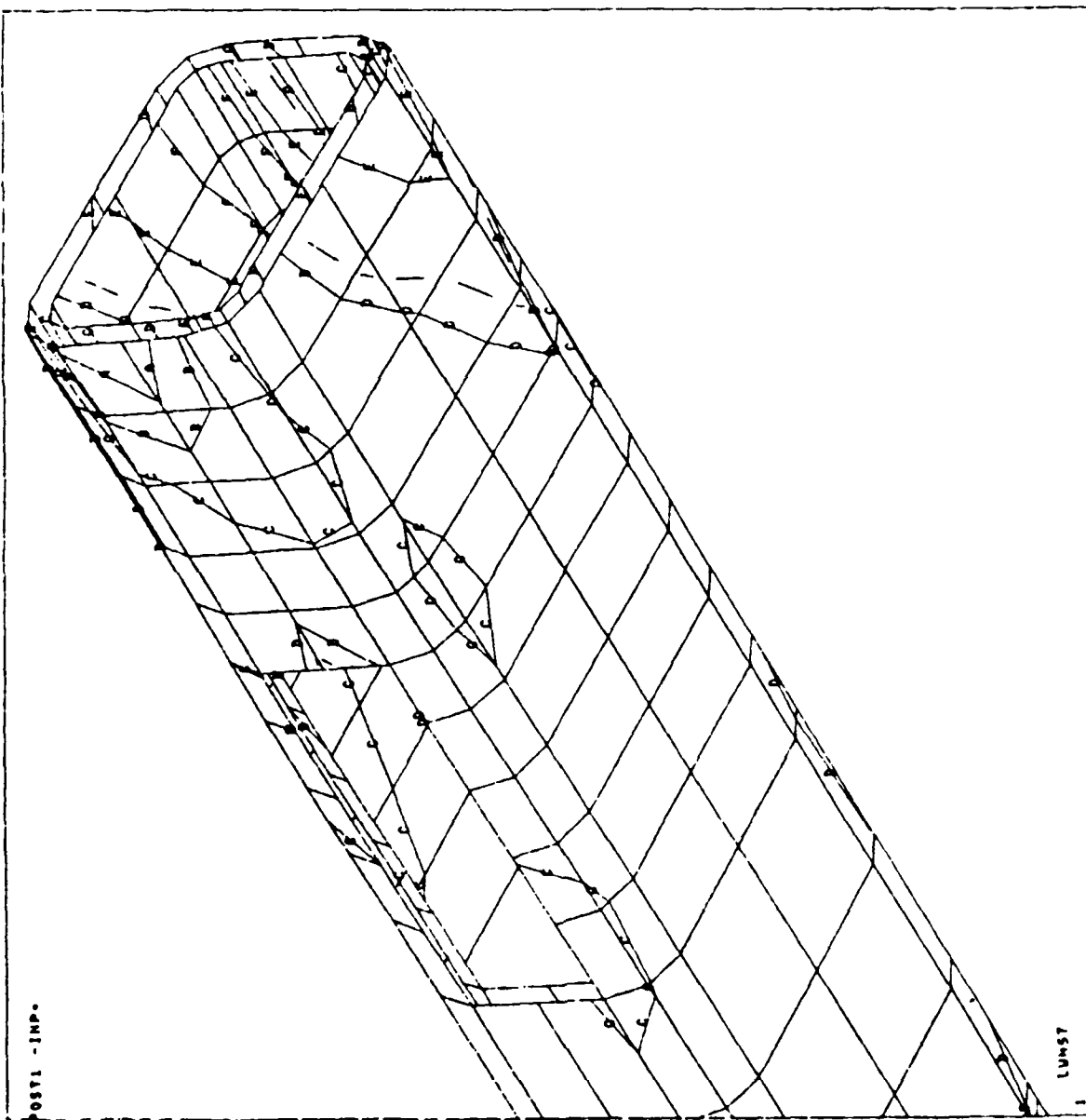
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 3 VF=16
 4 2F=150
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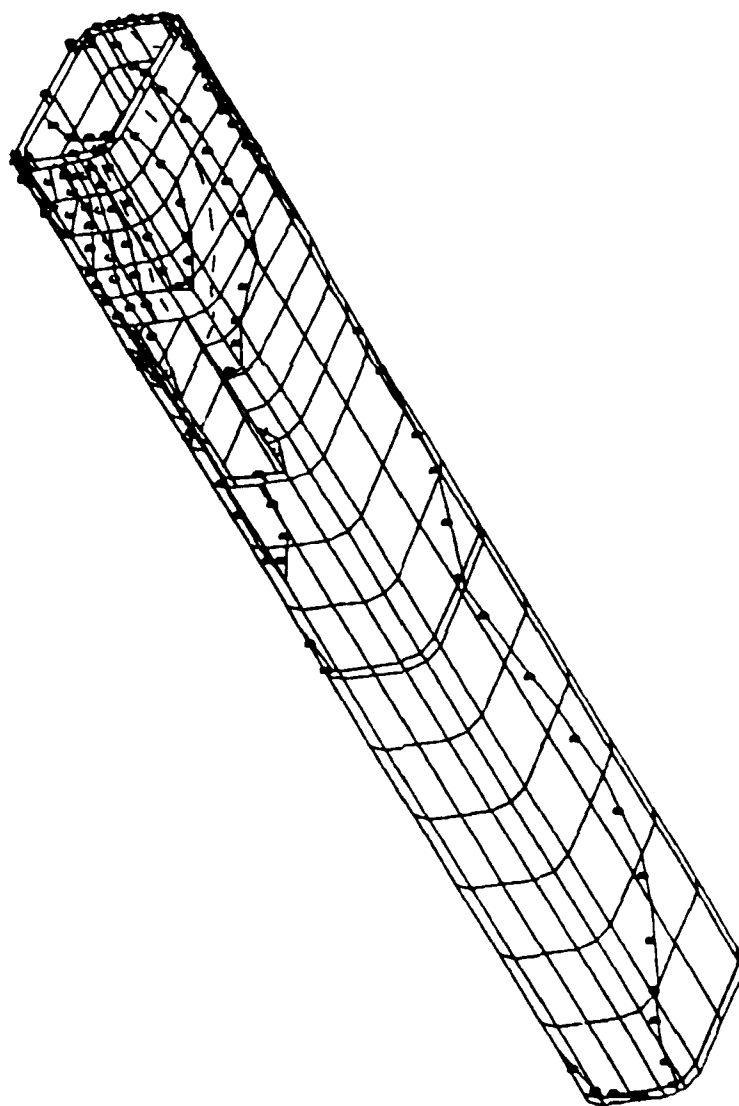


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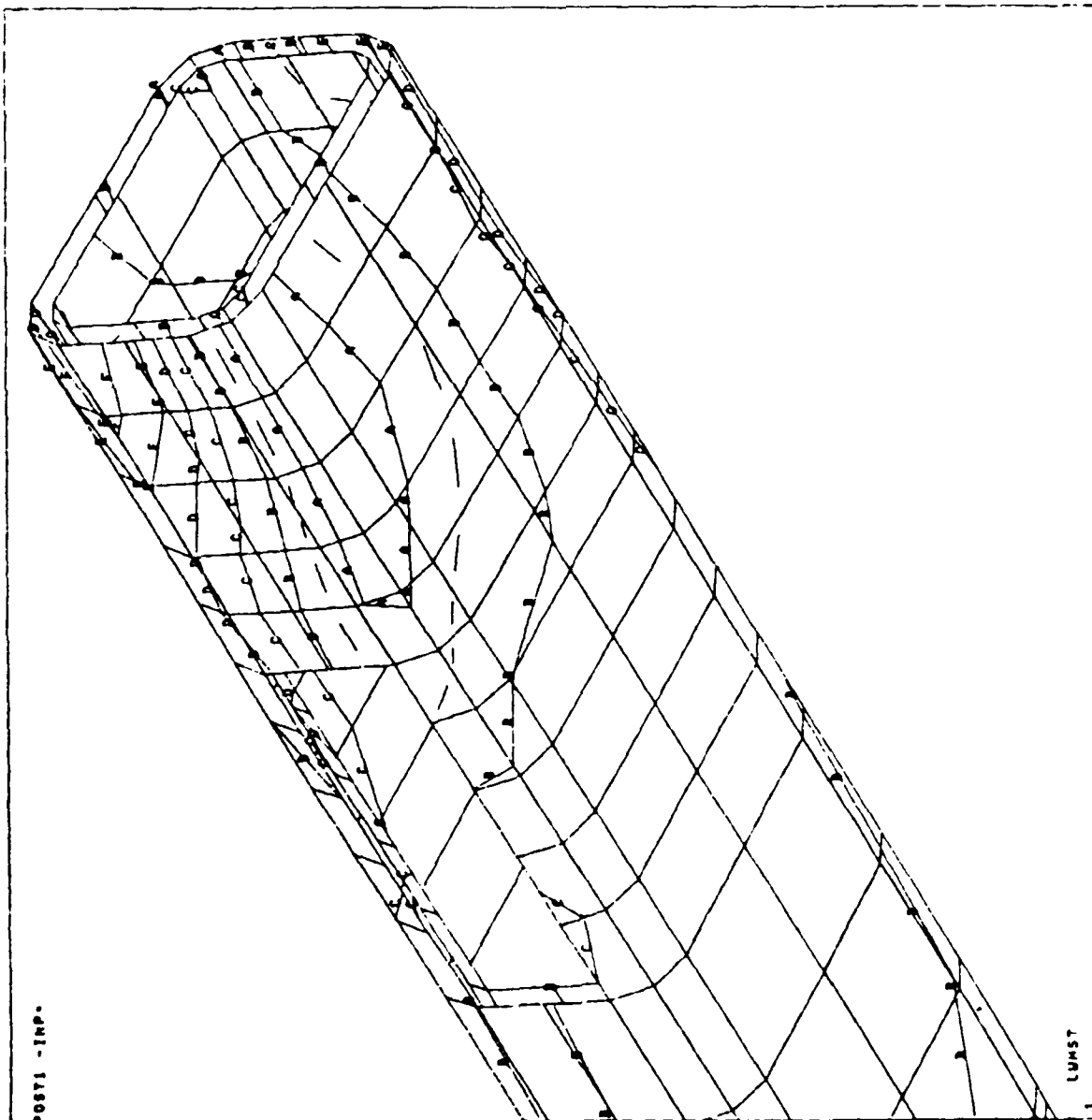
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 3 VF=16
 4 ZF=159
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 E=797
 F=1843



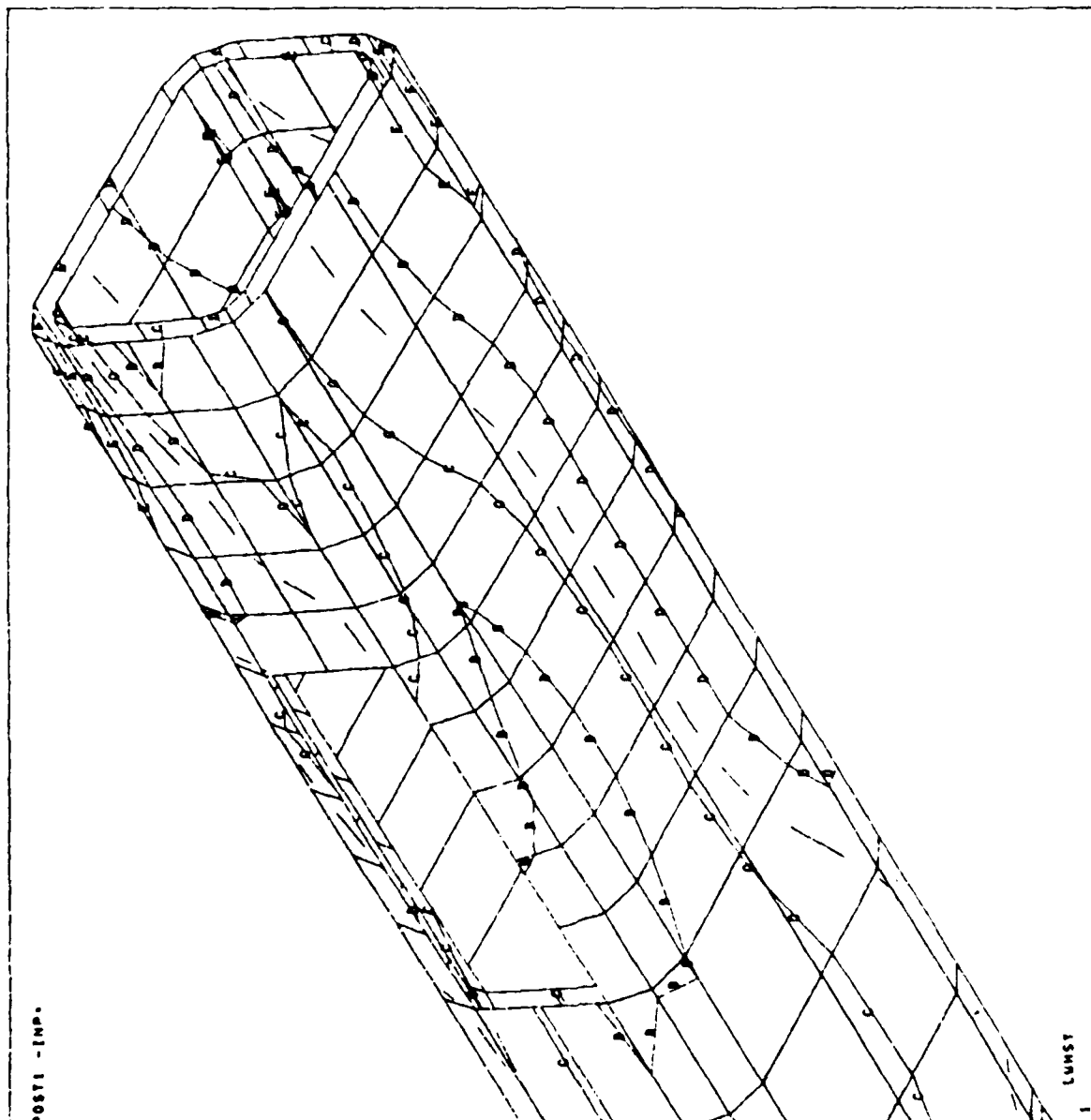
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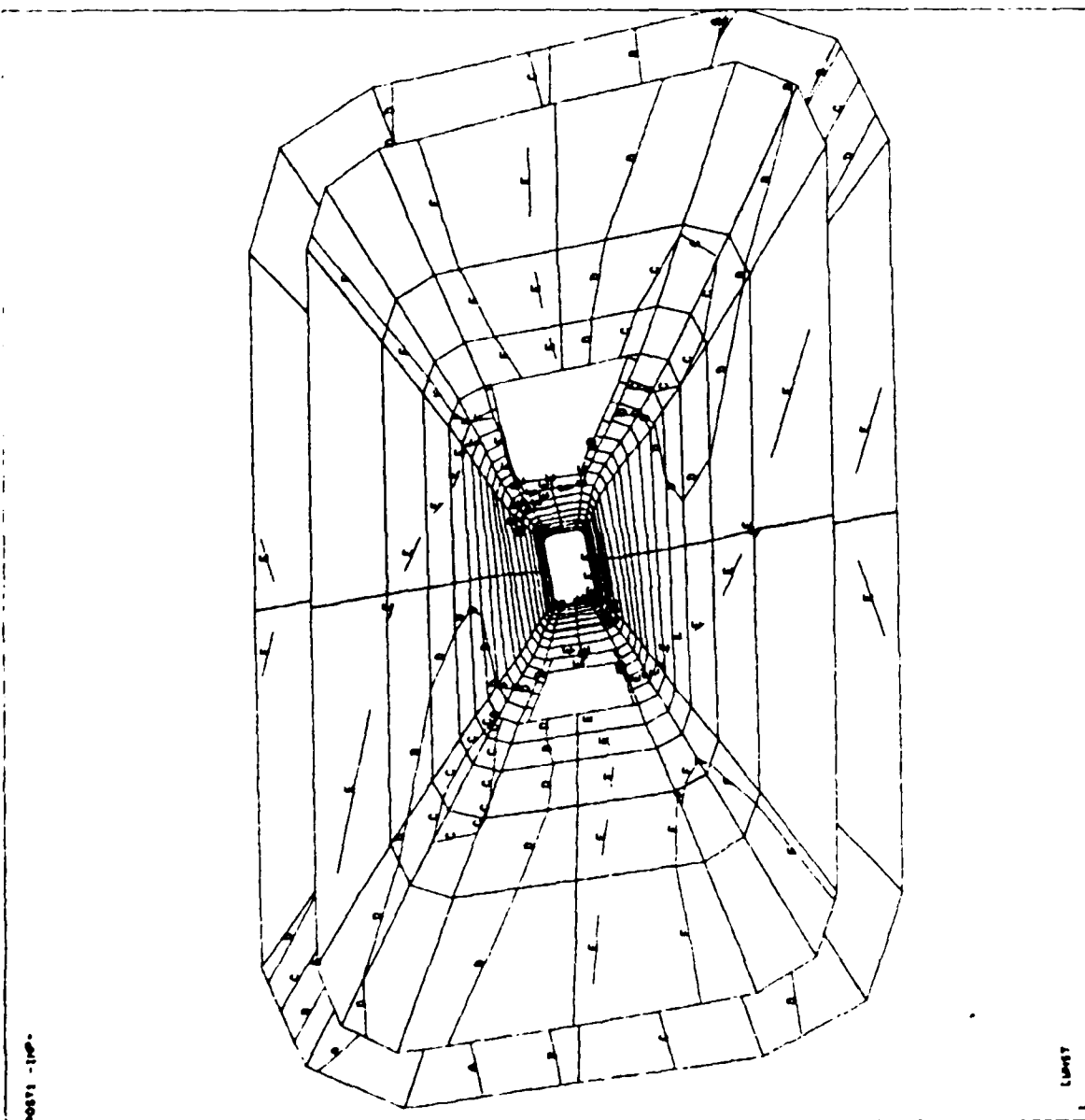
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 1 ZF=159
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 F=38666



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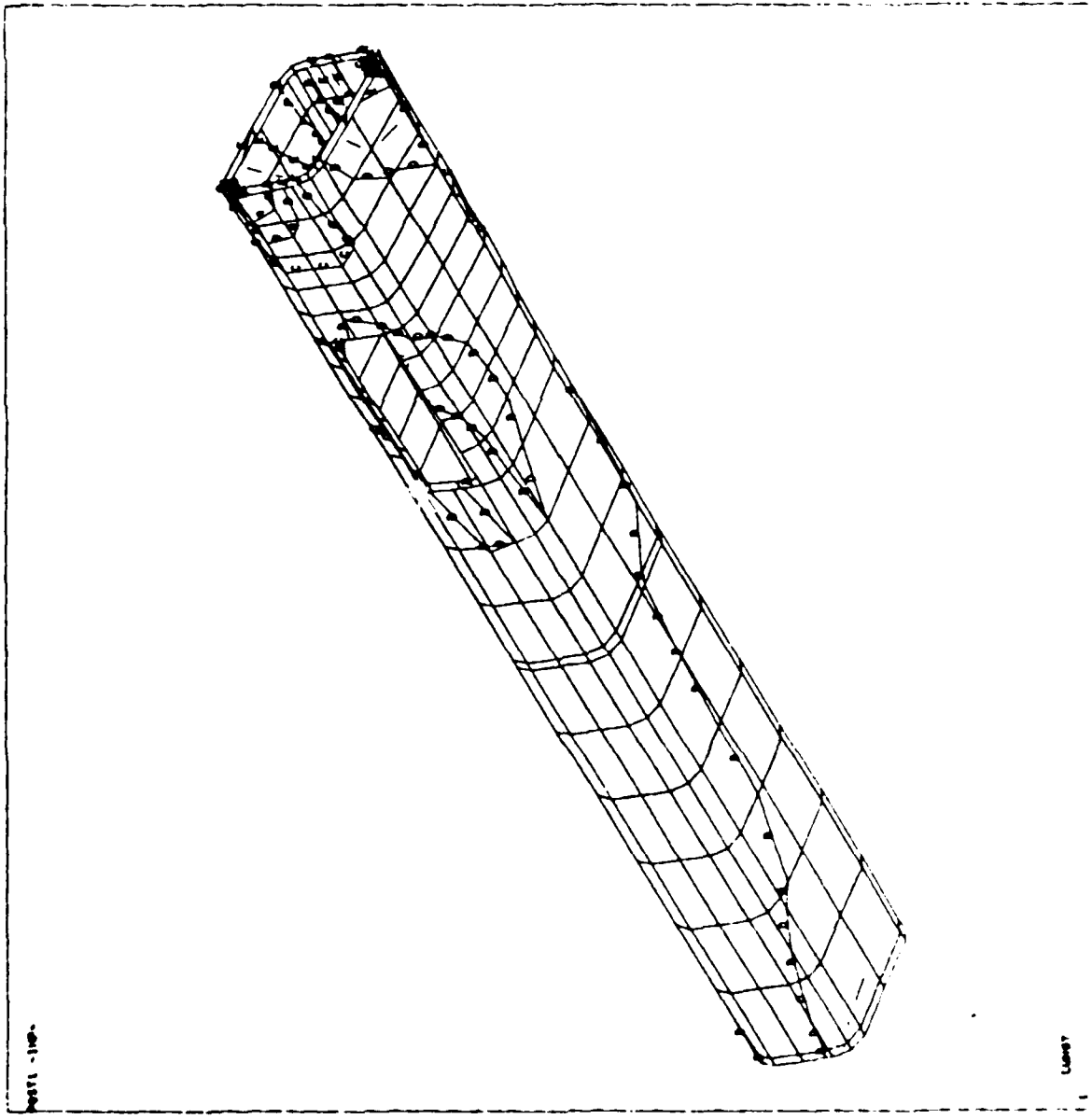


A complex geometric diagram showing a perspective view of a rectangular prism or a similar three-dimensional structure. The structure is defined by a grid of lines that converge towards a central point, creating a sense of depth and perspective. The lines are drawn in a way that suggests a three-dimensional space, with some lines being solid and others dashed to indicate hidden edges. The overall shape is elongated and tapers towards the center, resembling a tunnel or a perspective view of a rectangular prism. The diagram is composed of numerous lines and points, creating a dense and intricate pattern. The lines are drawn in a way that suggests a three-dimensional space, with some lines being solid and others dashed to indicate hidden edges. The overall shape is elongated and tapers towards the center, resembling a tunnel or a perspective view of a rectangular prism. The diagram is composed of numerous lines and points, creating a dense and intricate pattern.

100-110

1. Study

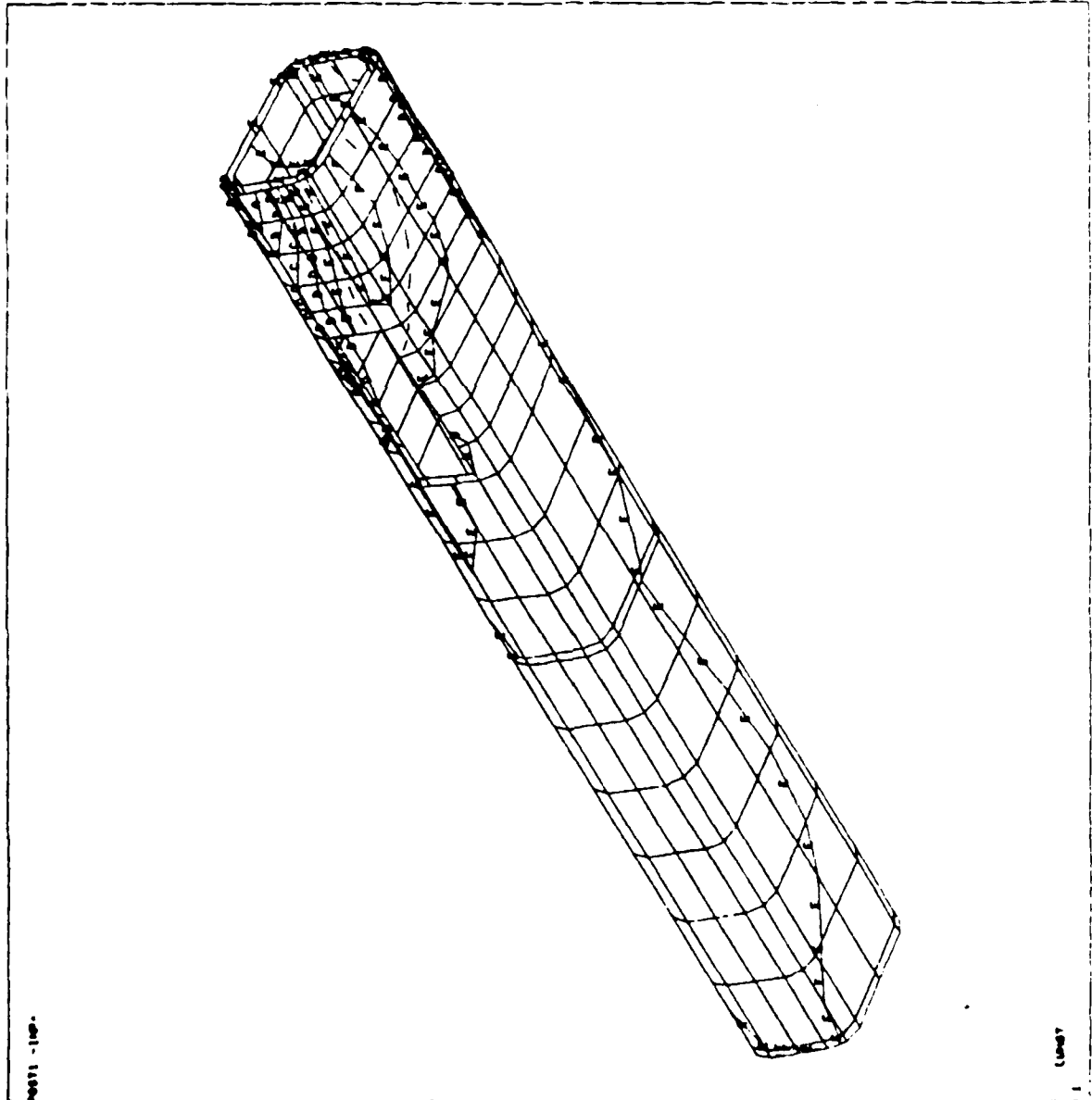
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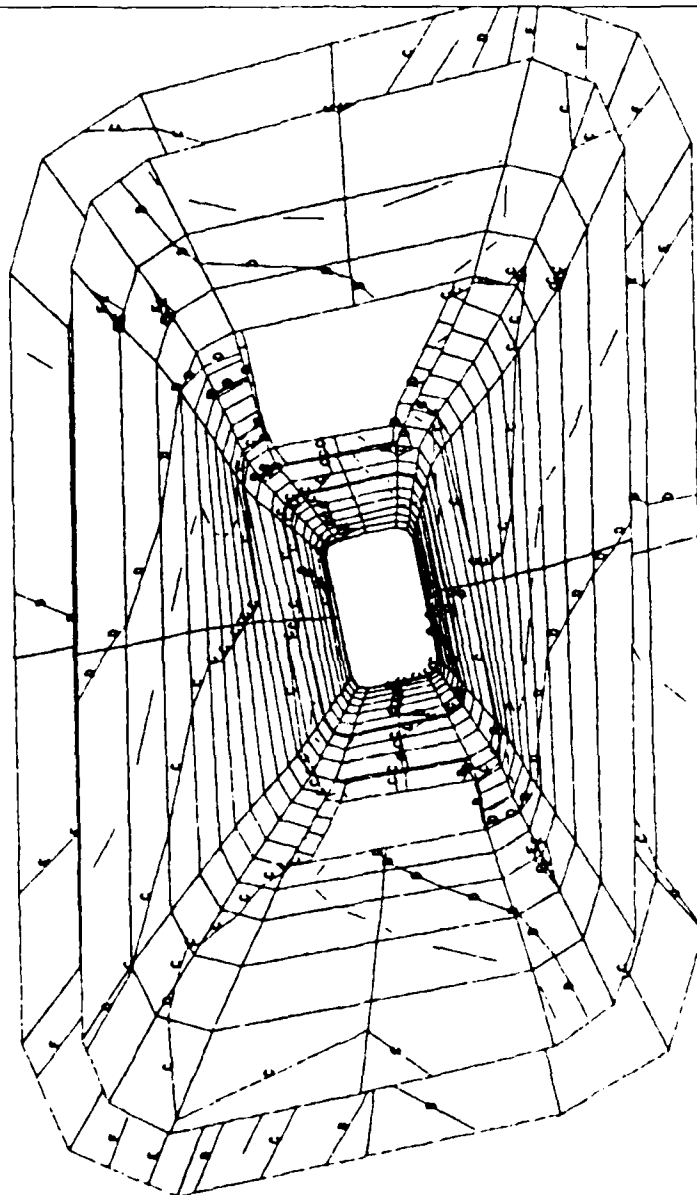
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10007

0011-100-
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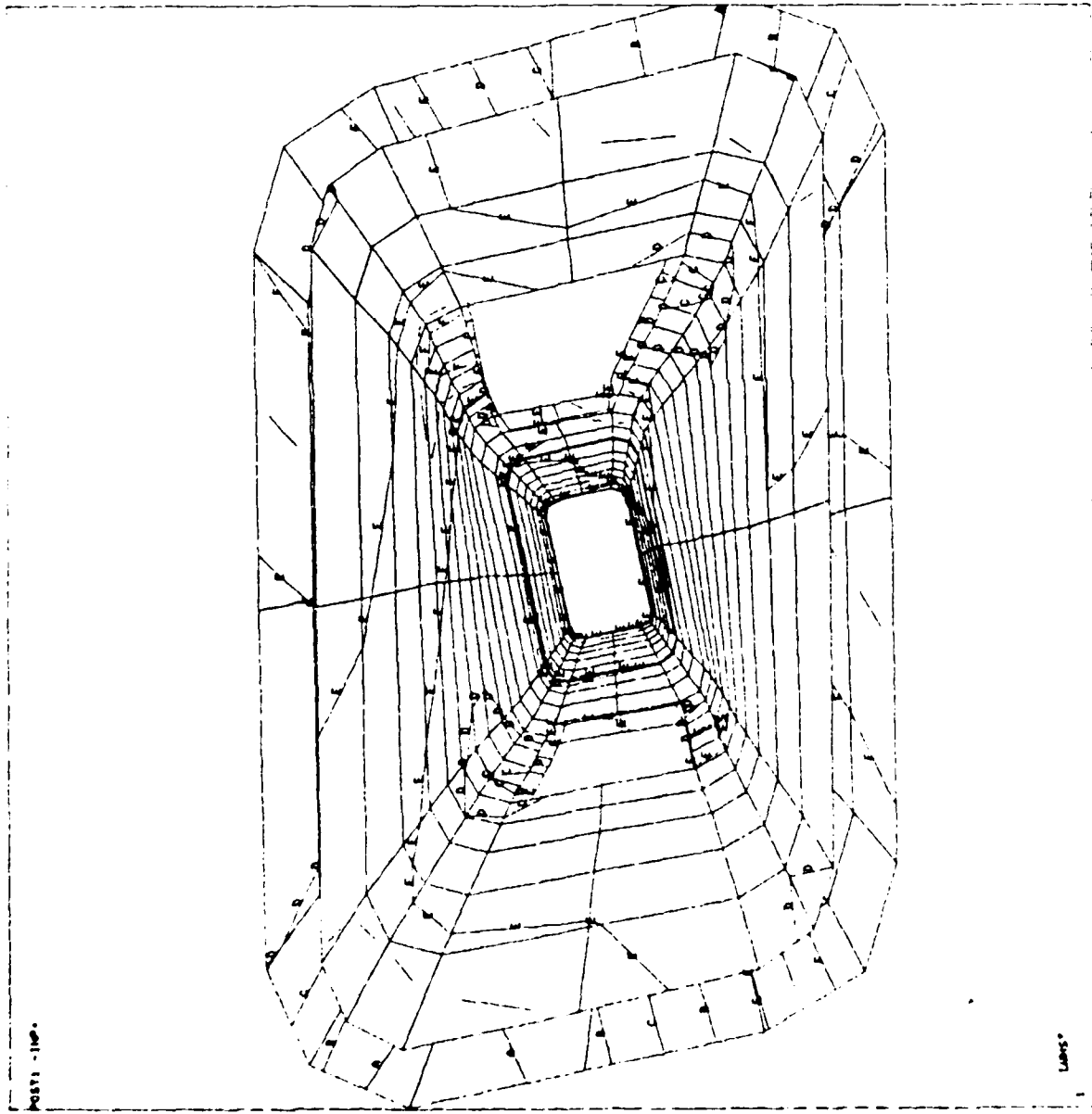
1580 - 1971



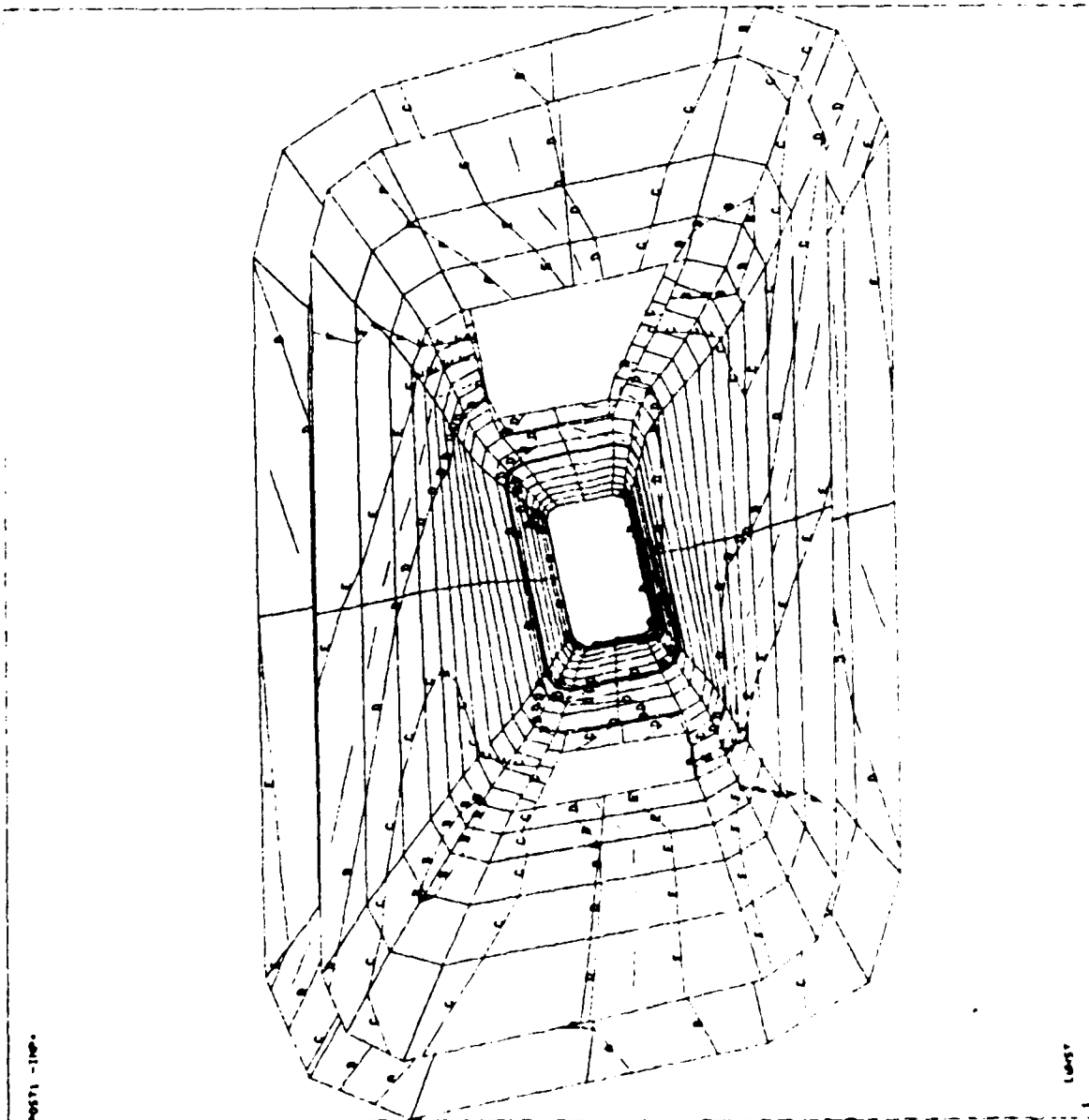
Page 9

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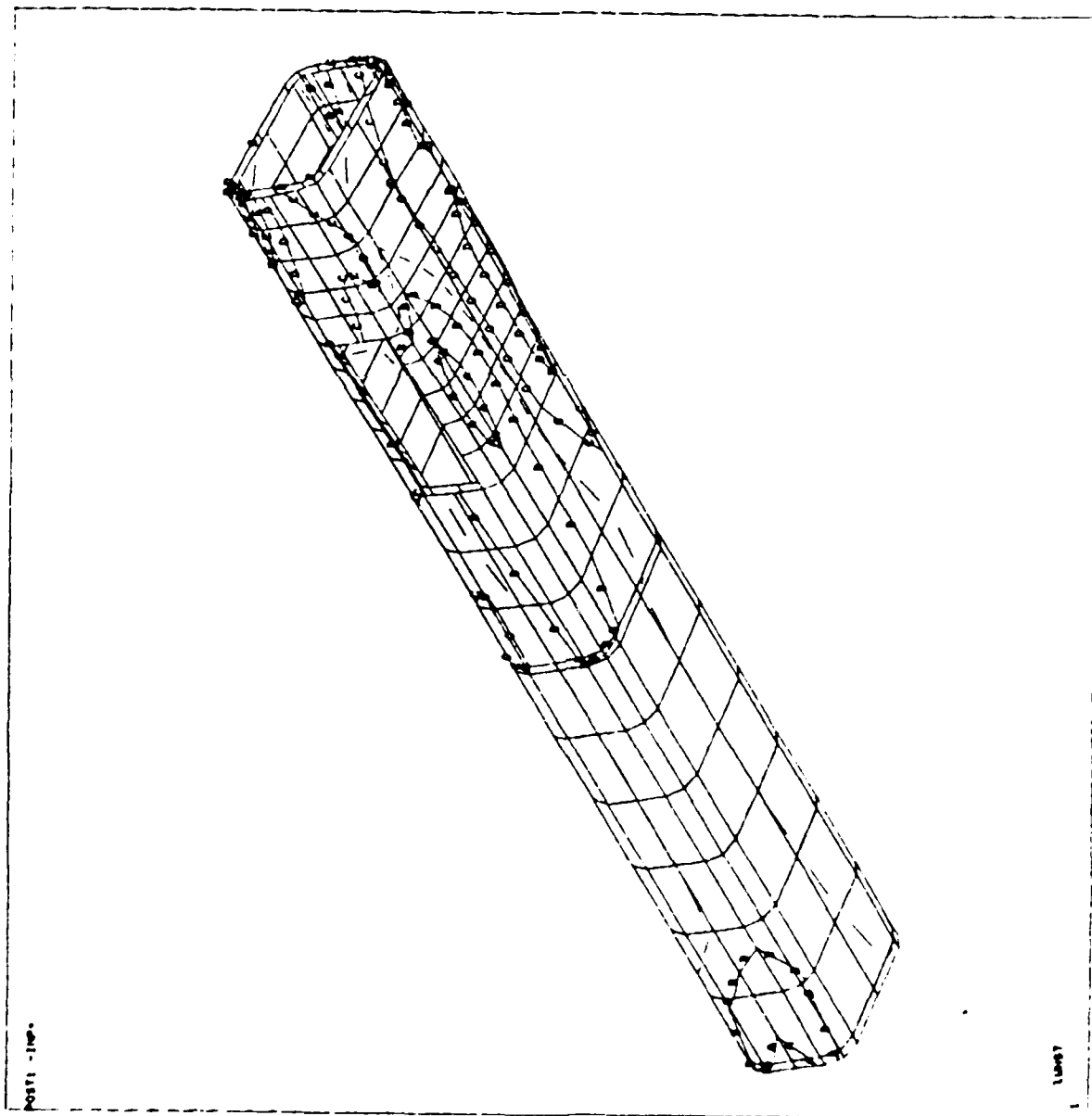


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 5/2
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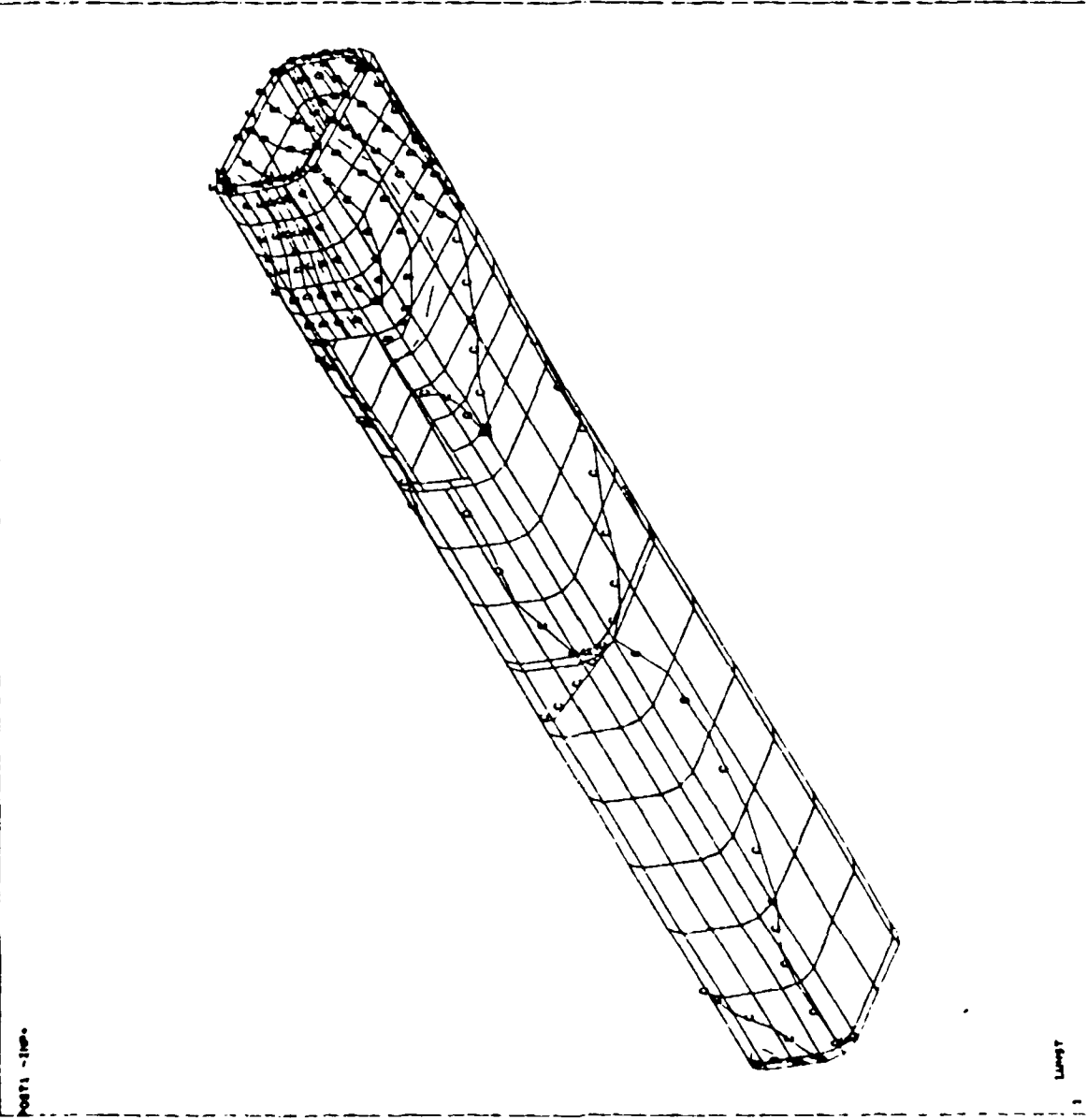


17

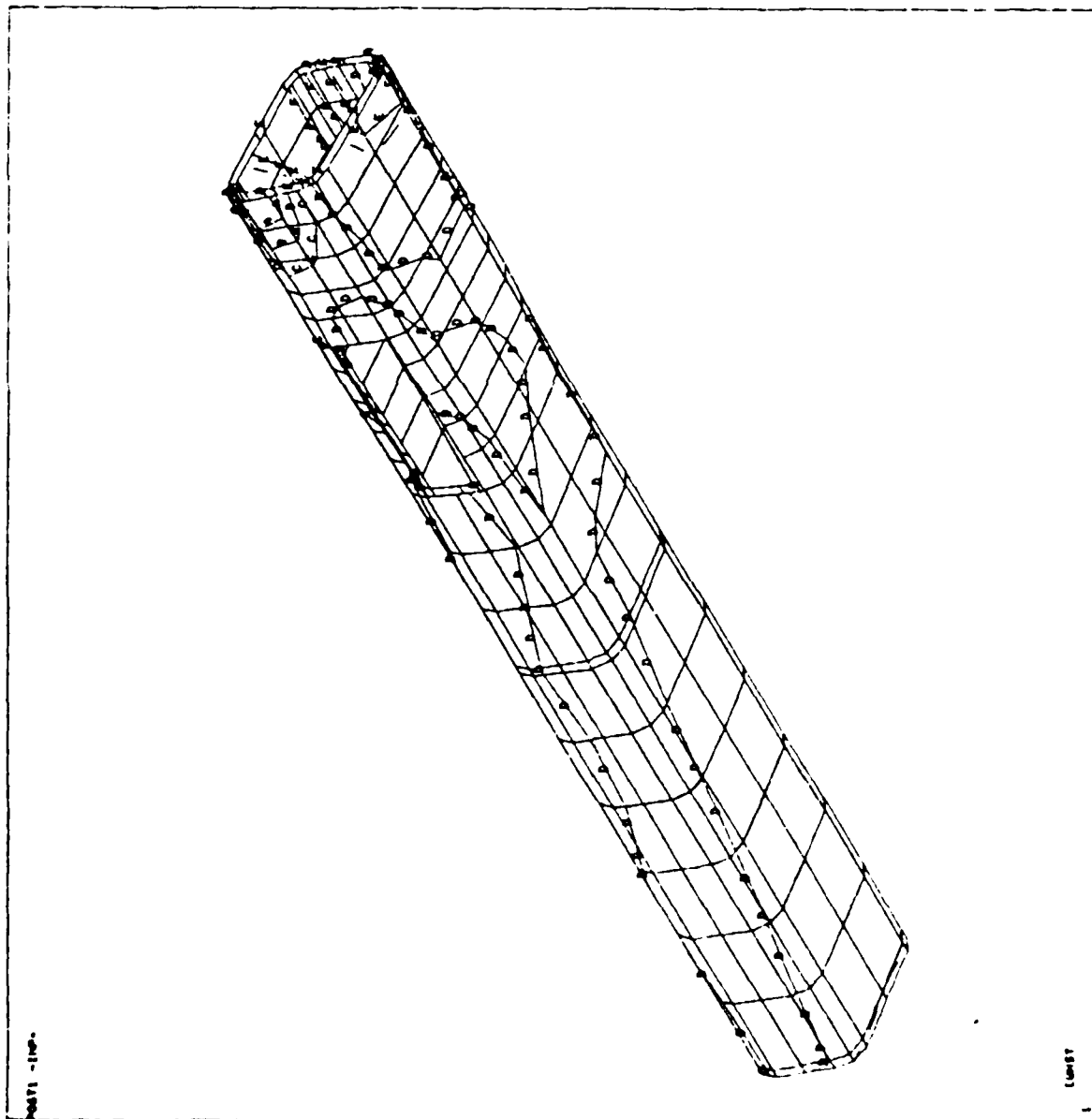
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 C=478
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 F=3200



ANALYSIS 4.128
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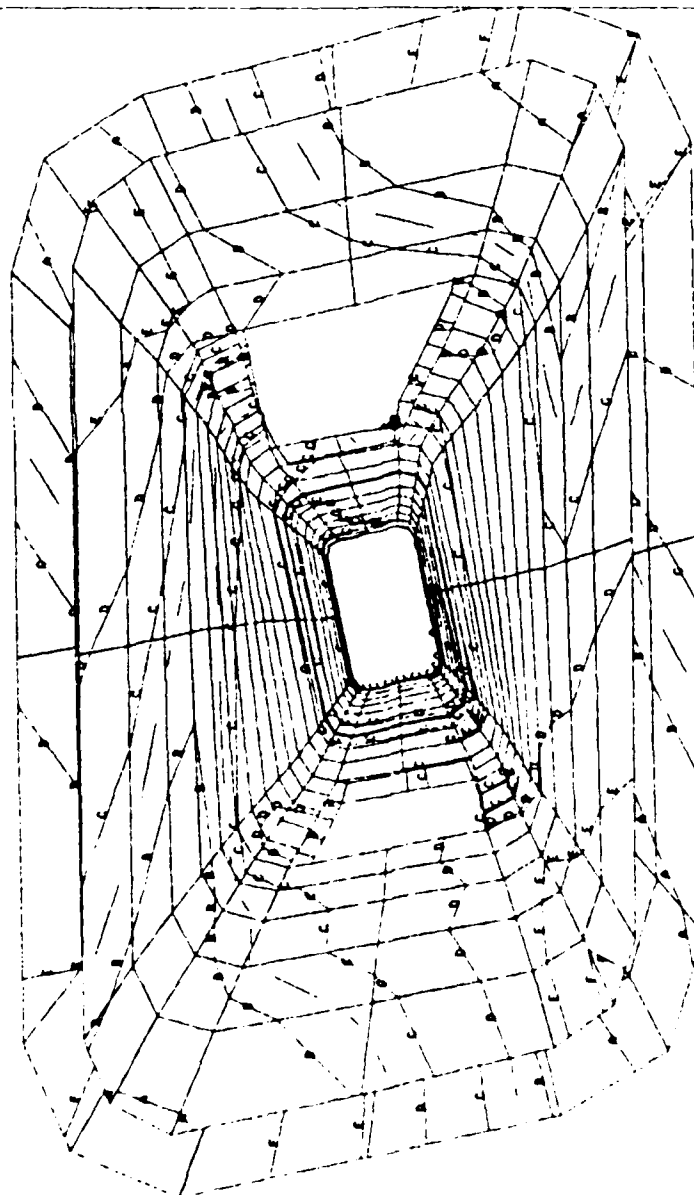


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 NU=1
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106

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 14:03:28
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 20-1
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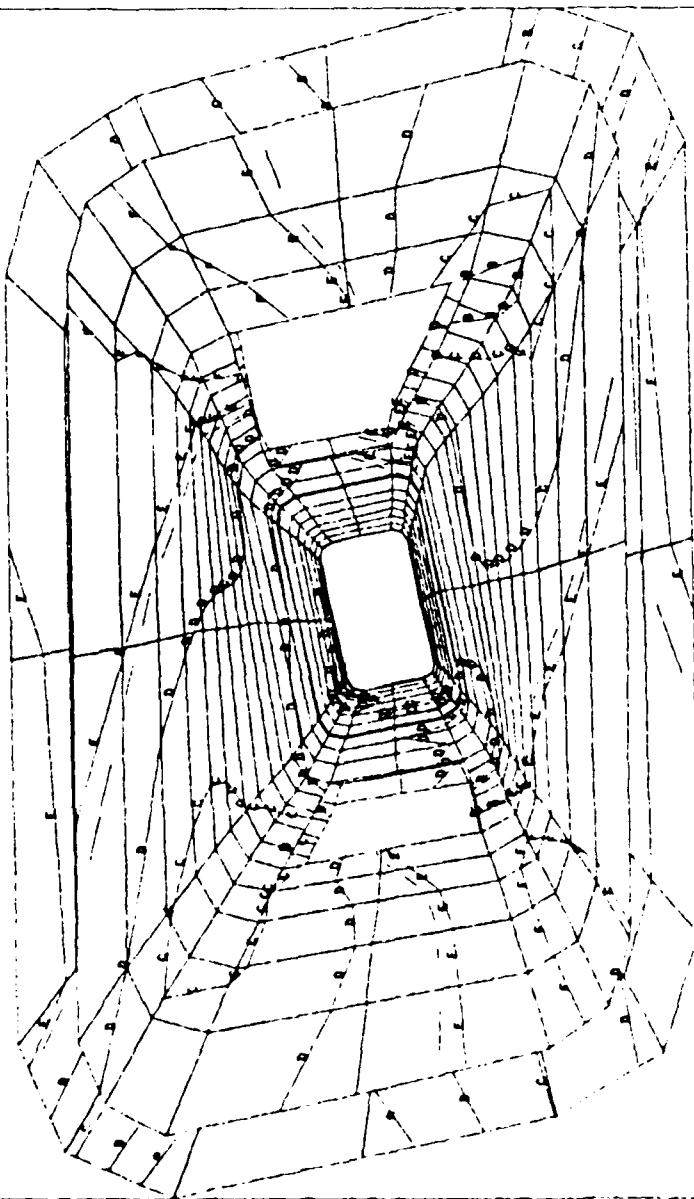


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LMESH

107

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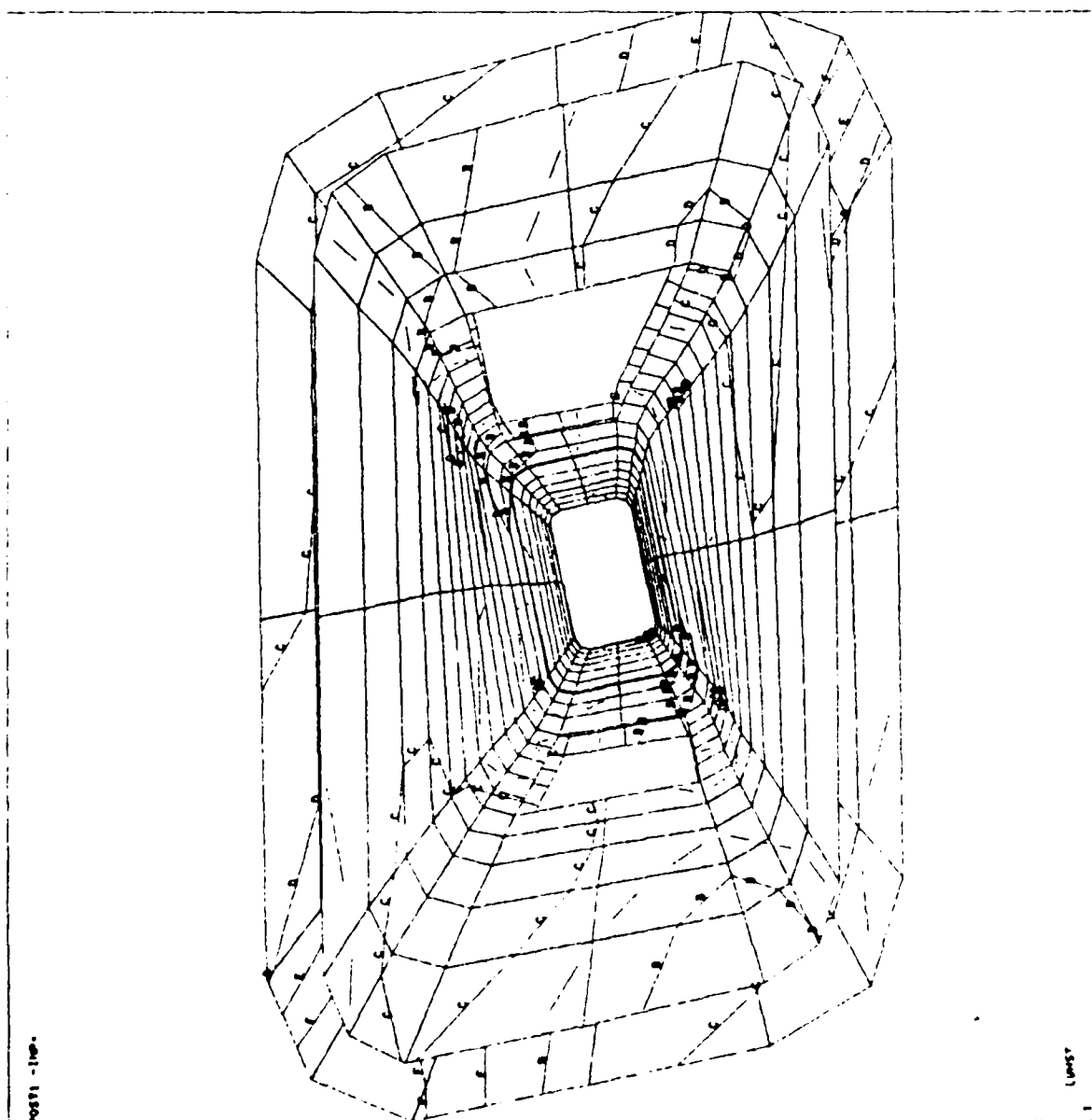
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11001

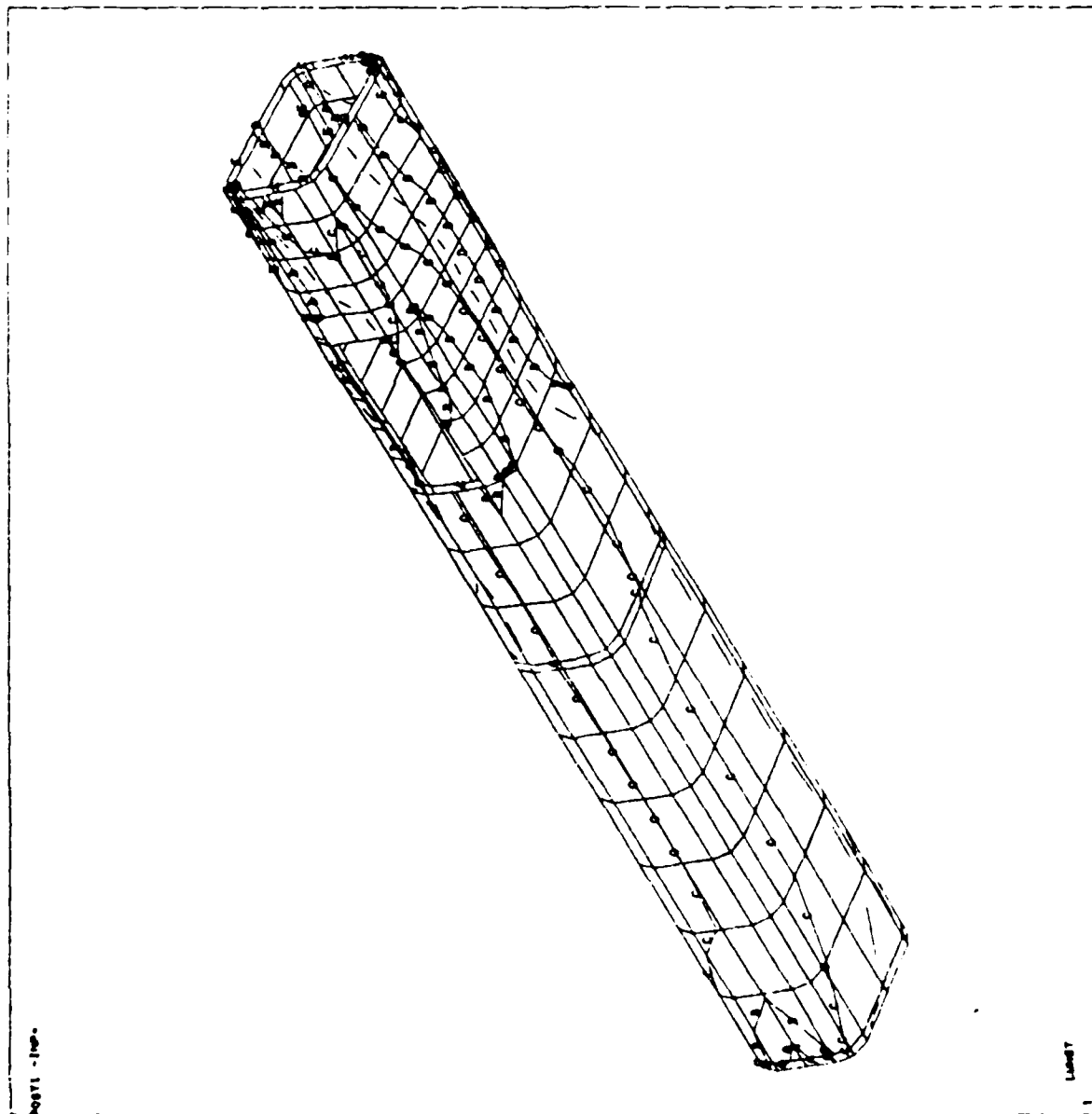
108

32 105

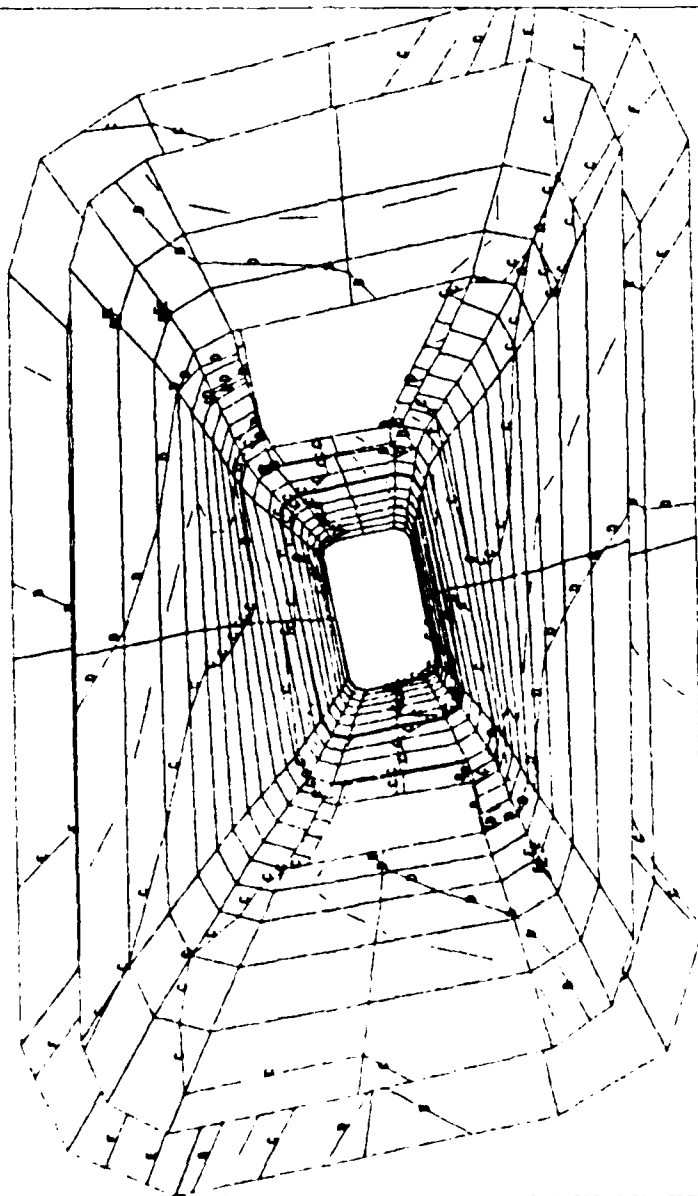
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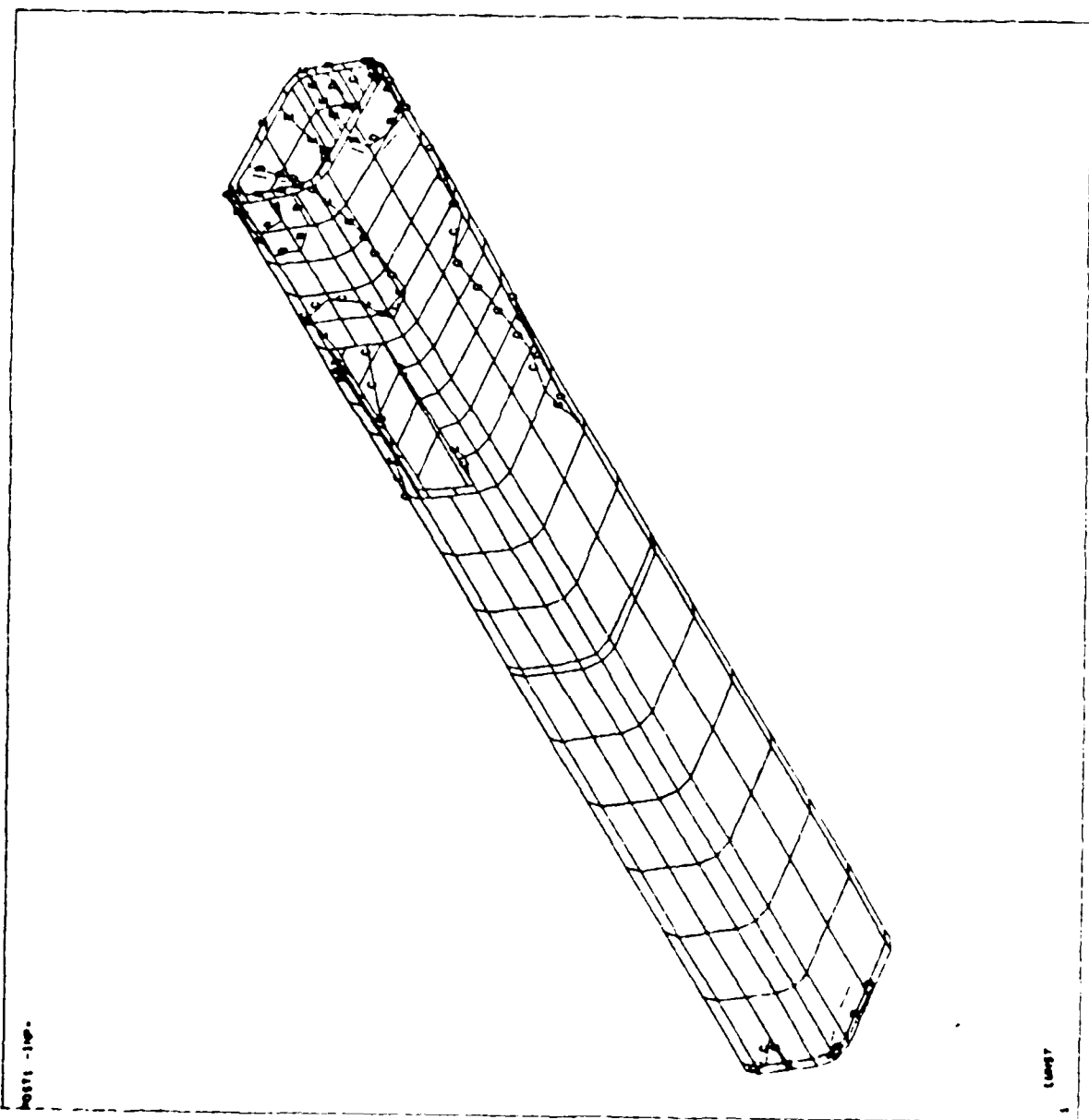
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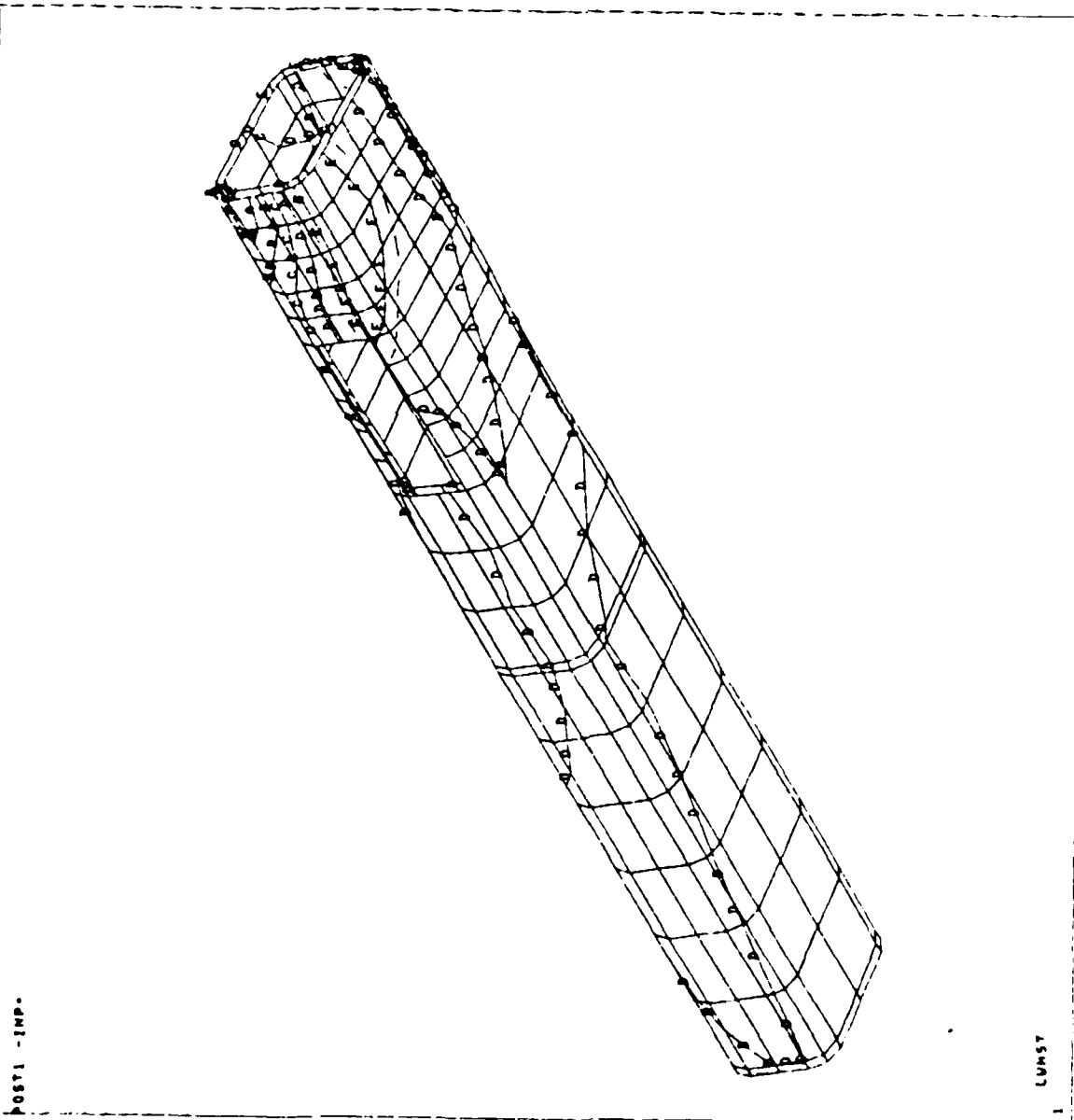
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14087

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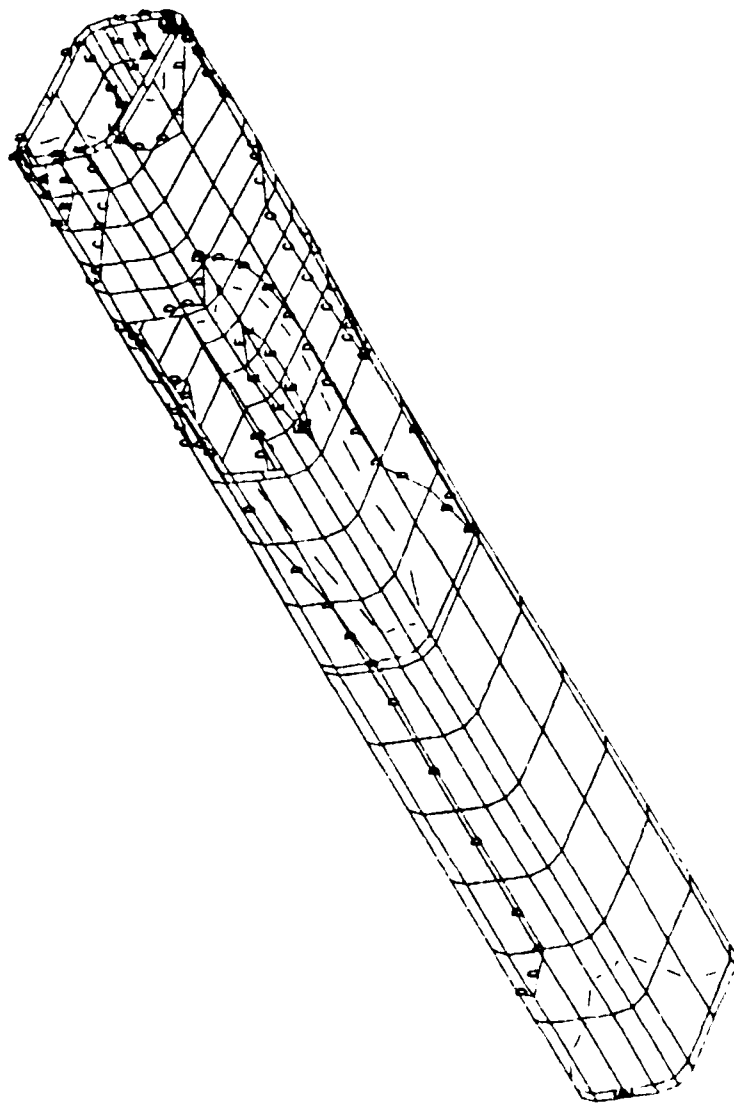
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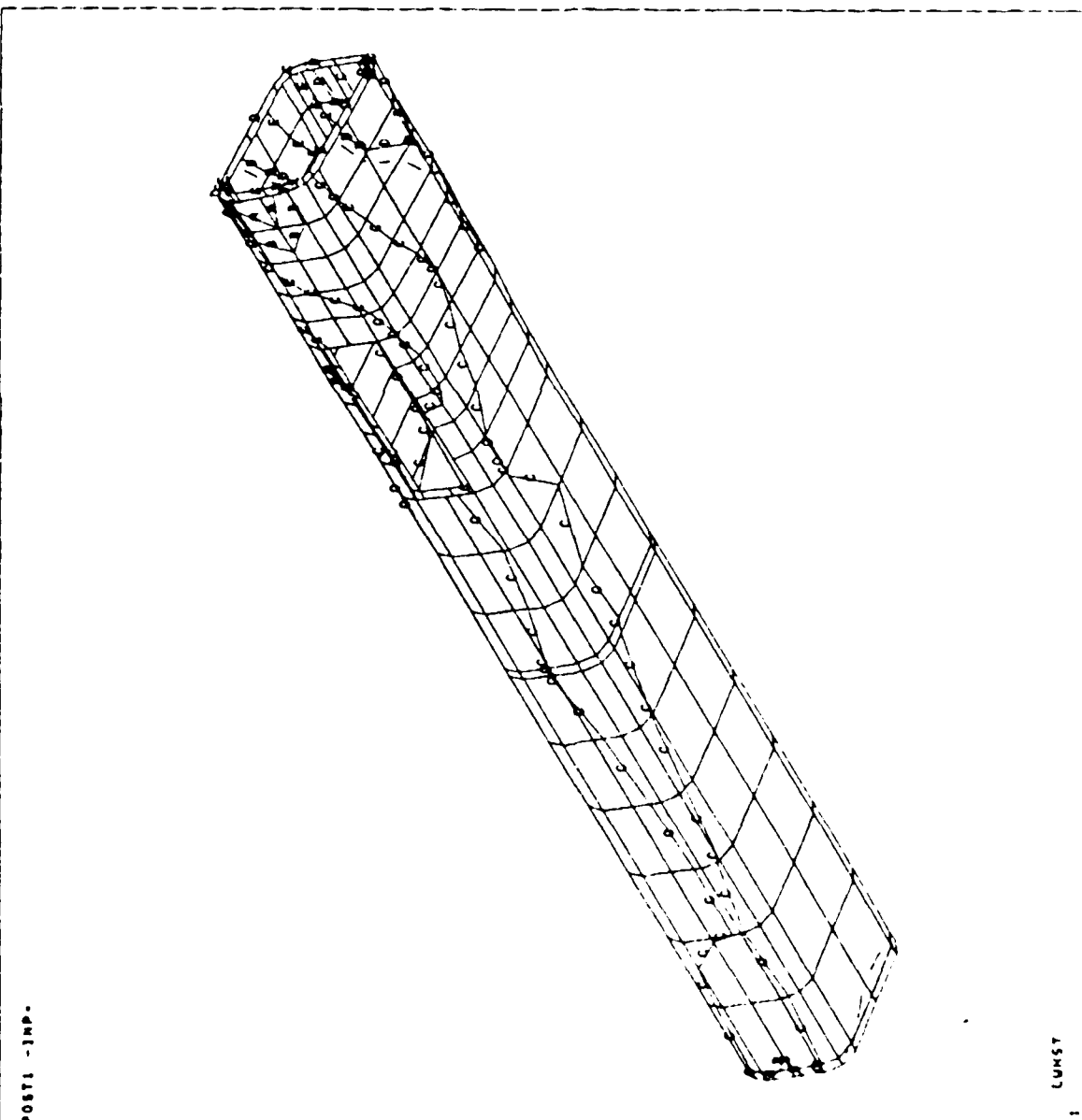
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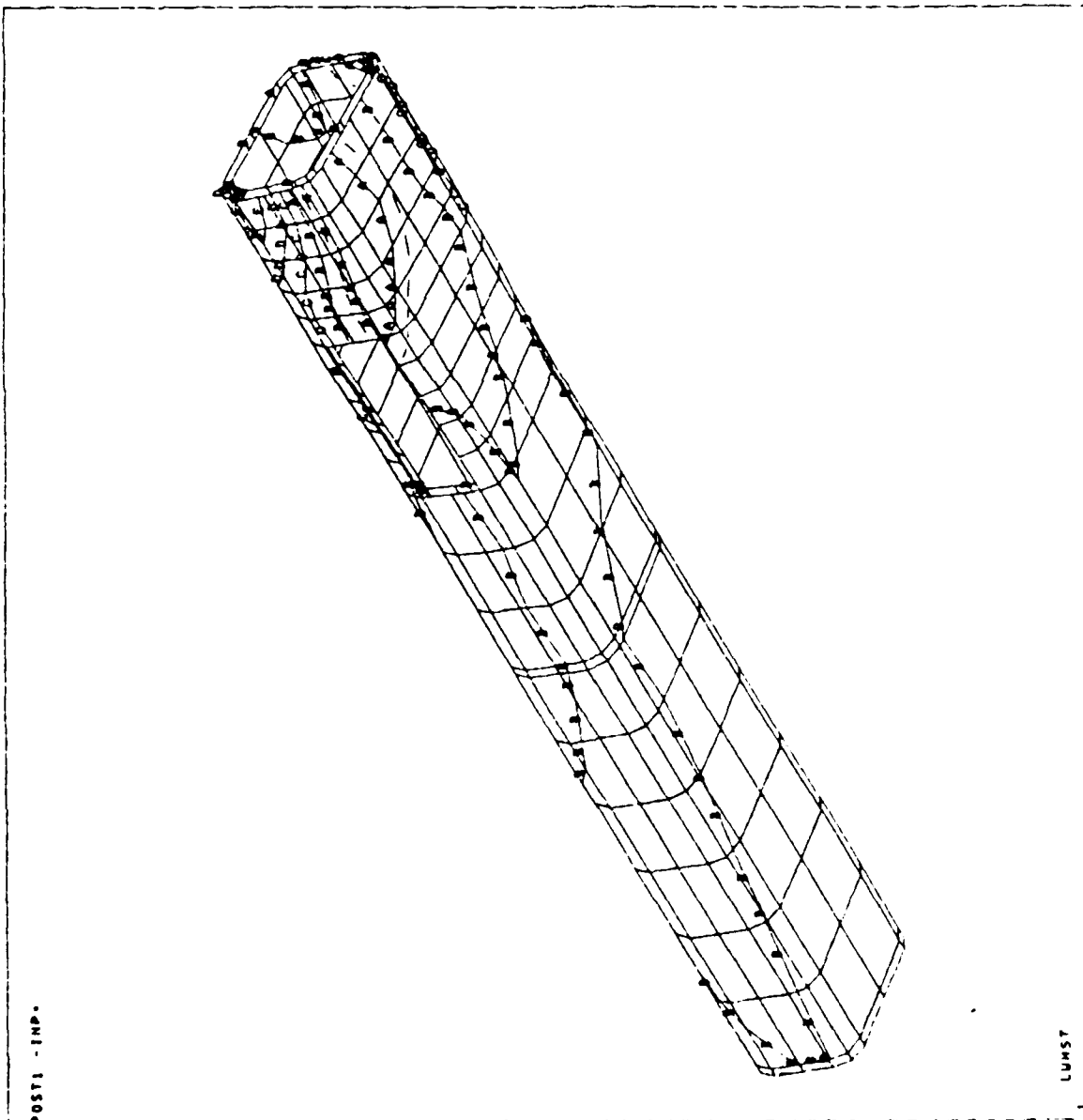


LUMST

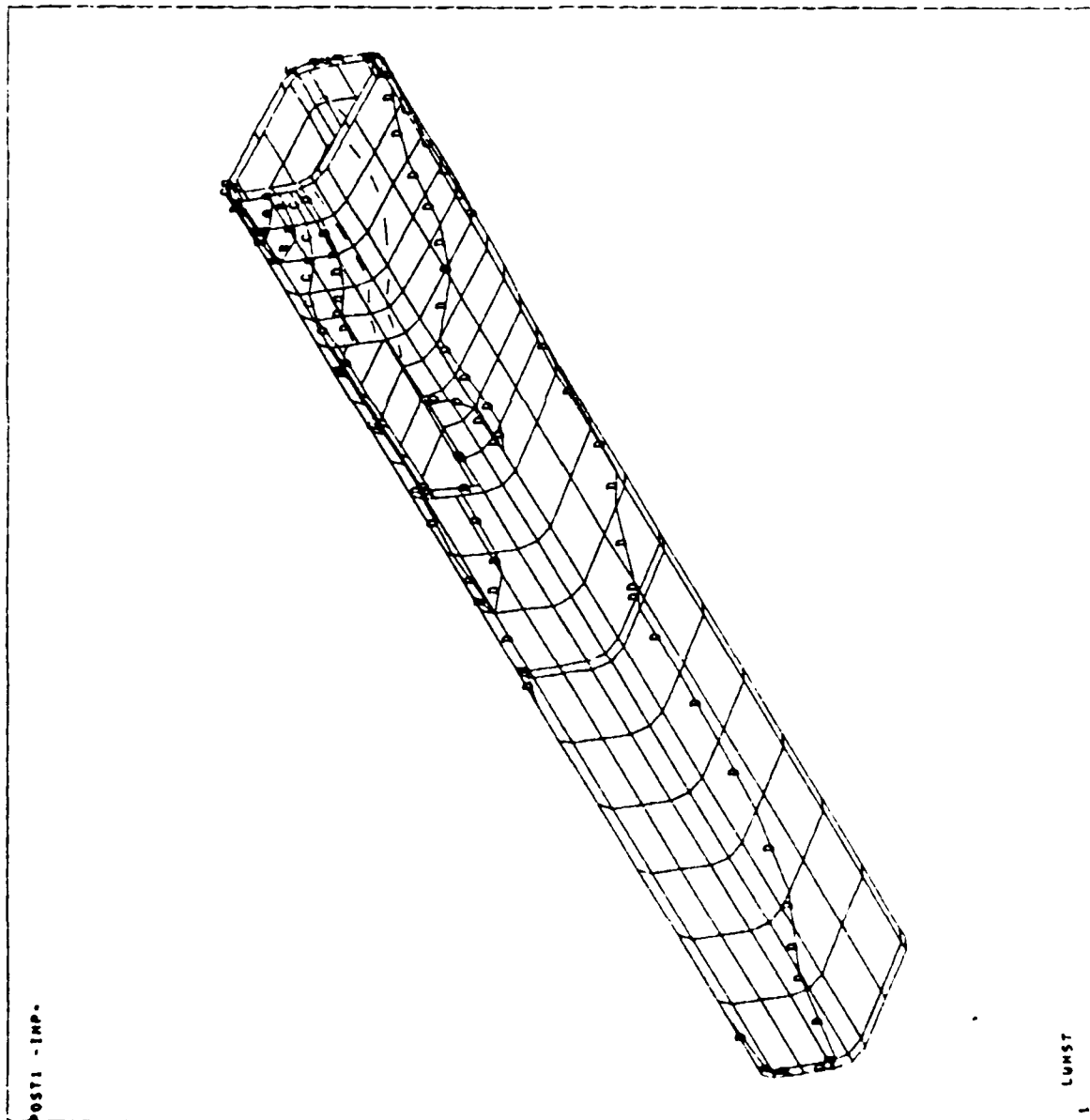
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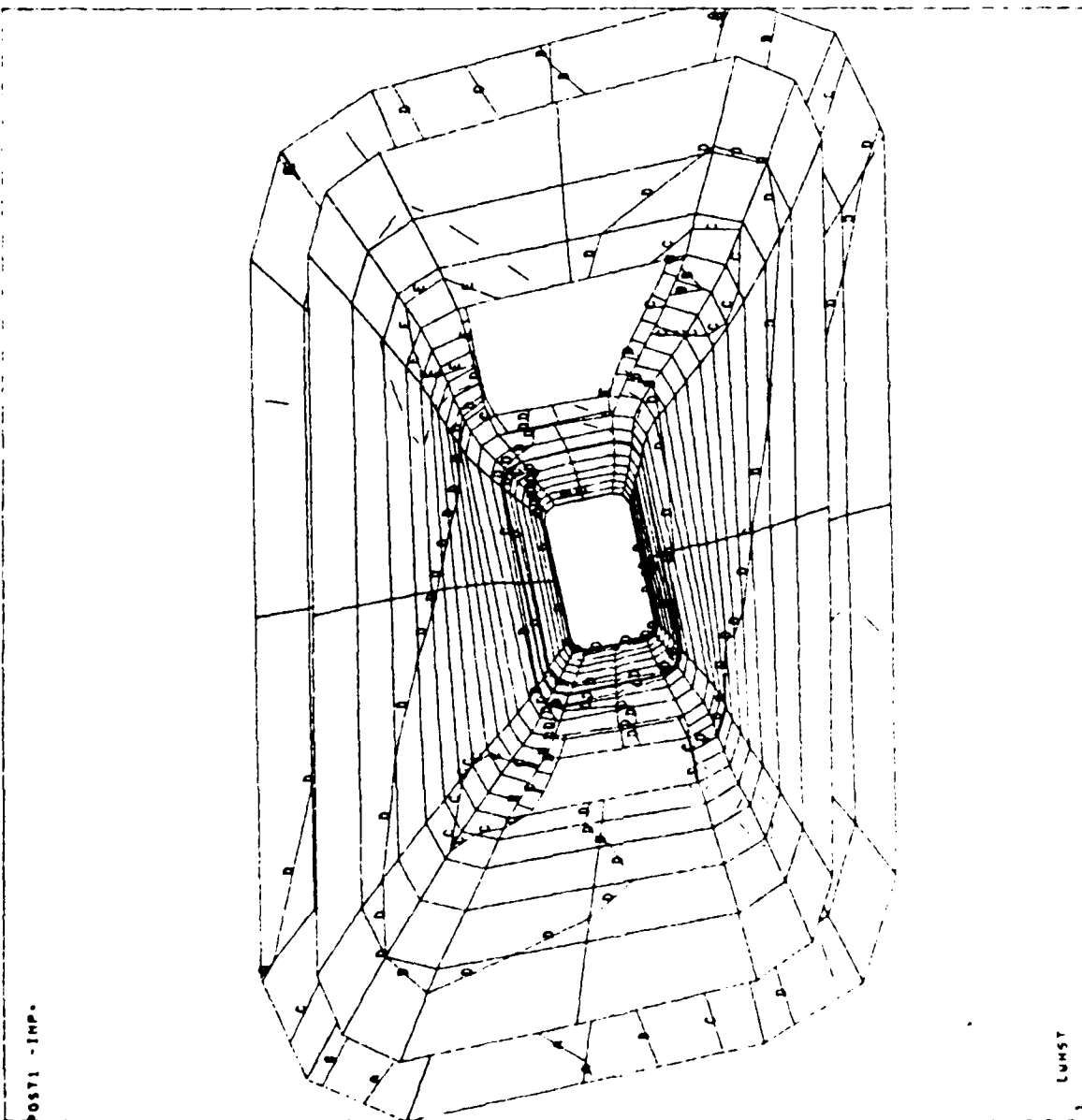
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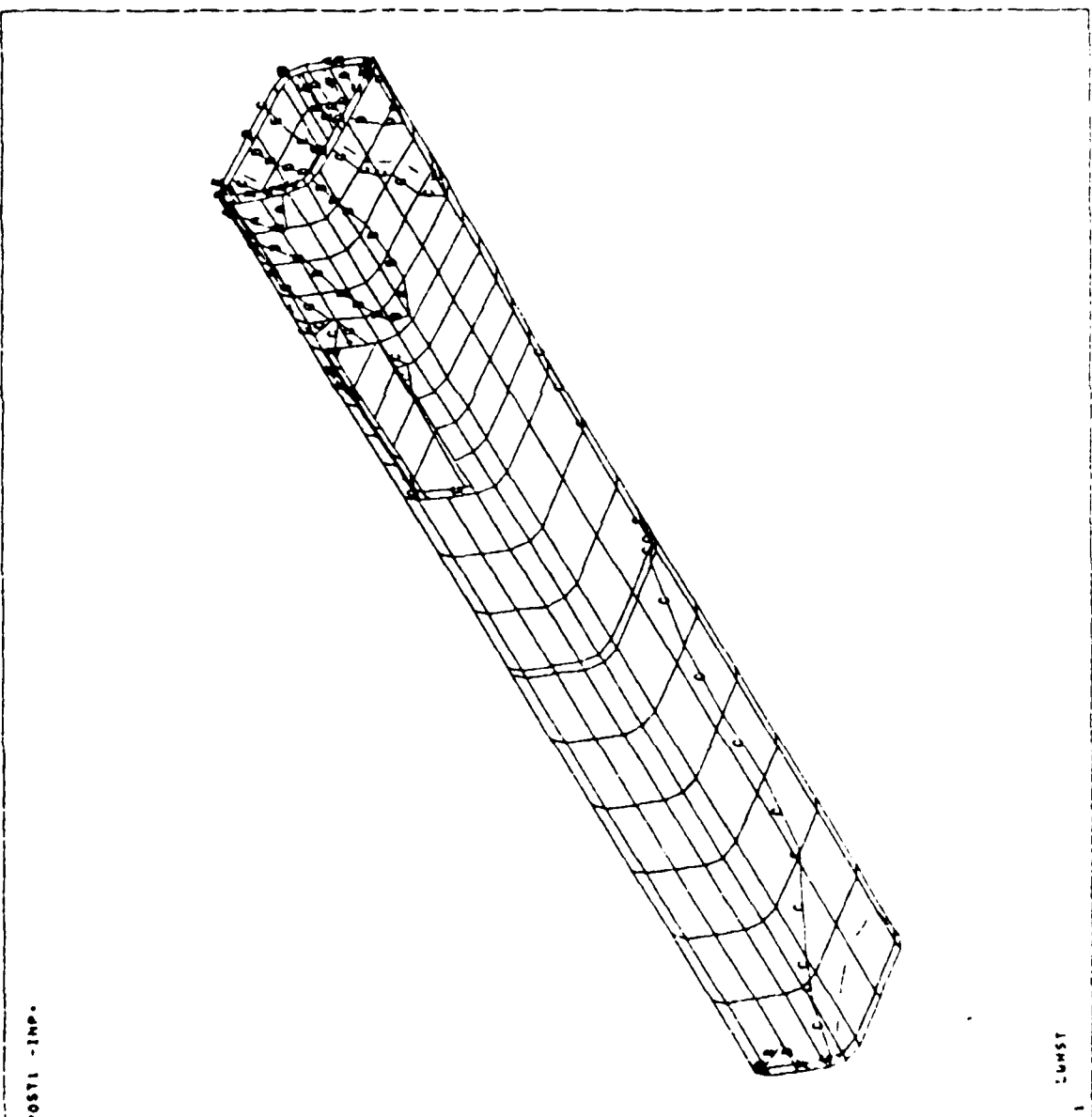
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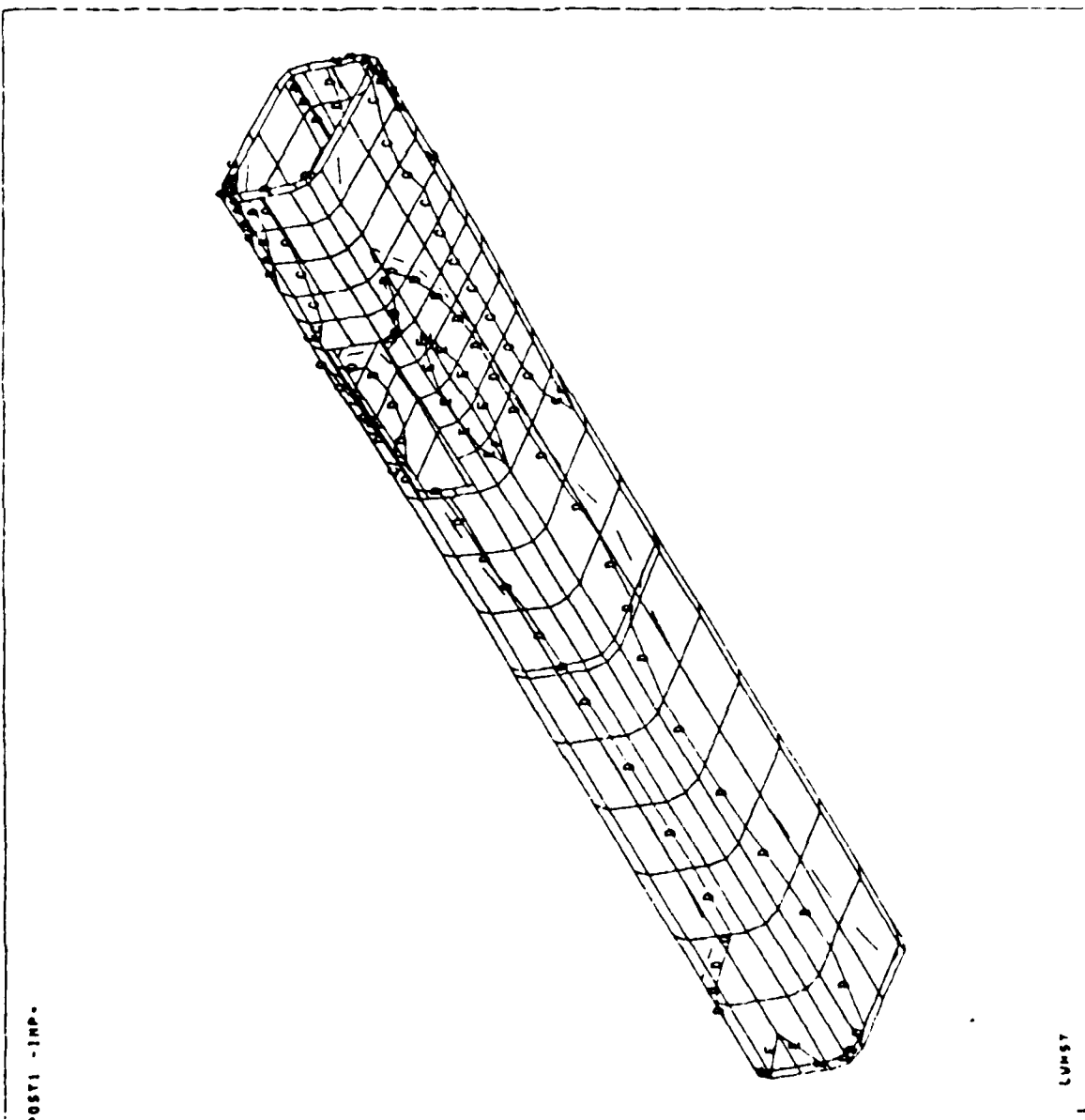
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 POST1 STRESS
 STEP=1
 IYER=1
 SRG
 ZU=1
 DIST=160
 ZF=116
 CONE=24
 MIDDEN
 MX=45174
 MN=-145233
 A=-113583
 B=-81831
 C=-58879
 D=-18327
 E=13425



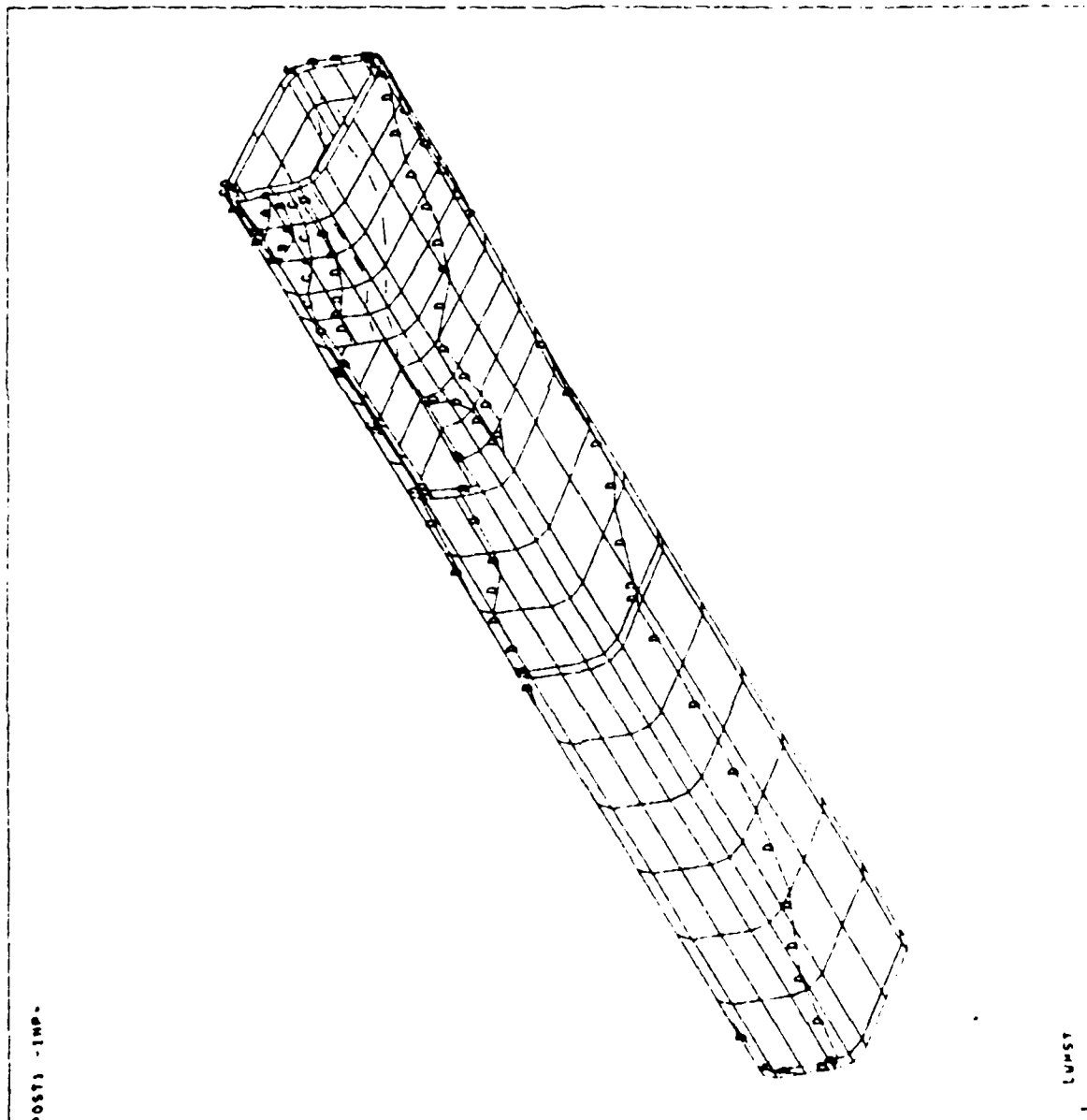
ANSYS 4.20
 DCC 4 1986
 15:48:26
 POST1 STRESS
 STEP=1
 LAYER=1
 SV6
 KU=-1
 VU=-1
 ZU=-1
 DIST=104
 ZF=116
 MIDDEN
 MX=2758
 MY=-3289
 MZ=2281
 B=-1873
 C=-265
 D=743
 E=1751



ANSYS 4.28
 DEC 4 1986
 15:49:55
 POST1 STRESS
 STEP=1
 LAYER=1
 SHE
 KU=-1
 VU=-1
 ZU=-1
 DIST=104
 ZF=116
 MIDDLEM
 PH=2359
 MH=-4192
 A=-3101
 B=-2009
 C=-817
 D=175
 E=1267



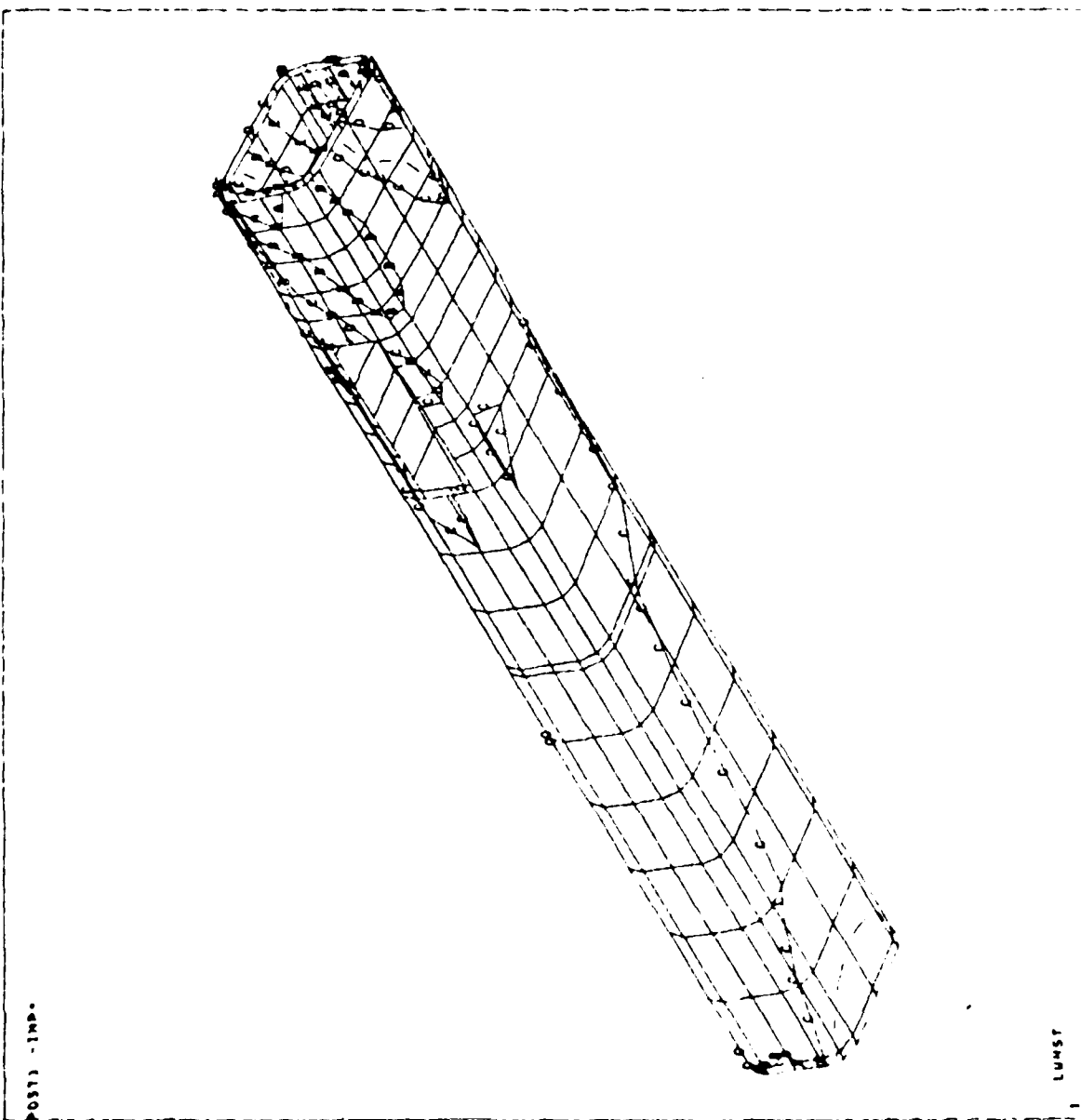
ANSYS 4.20
 D/C 4 1986
 IS:51126
 POST1 STRESS
 STEP=1
 ITER=1
 SK7
 KU=-1
 VU=-1
 ZU=-1
 DIST=104
 ZF=LLC
 MIDDLE
 MX=45010
 MY=-145109
 MZ=-113489
 B=-81789
 C=-50089
 D=-10389
 E=13311



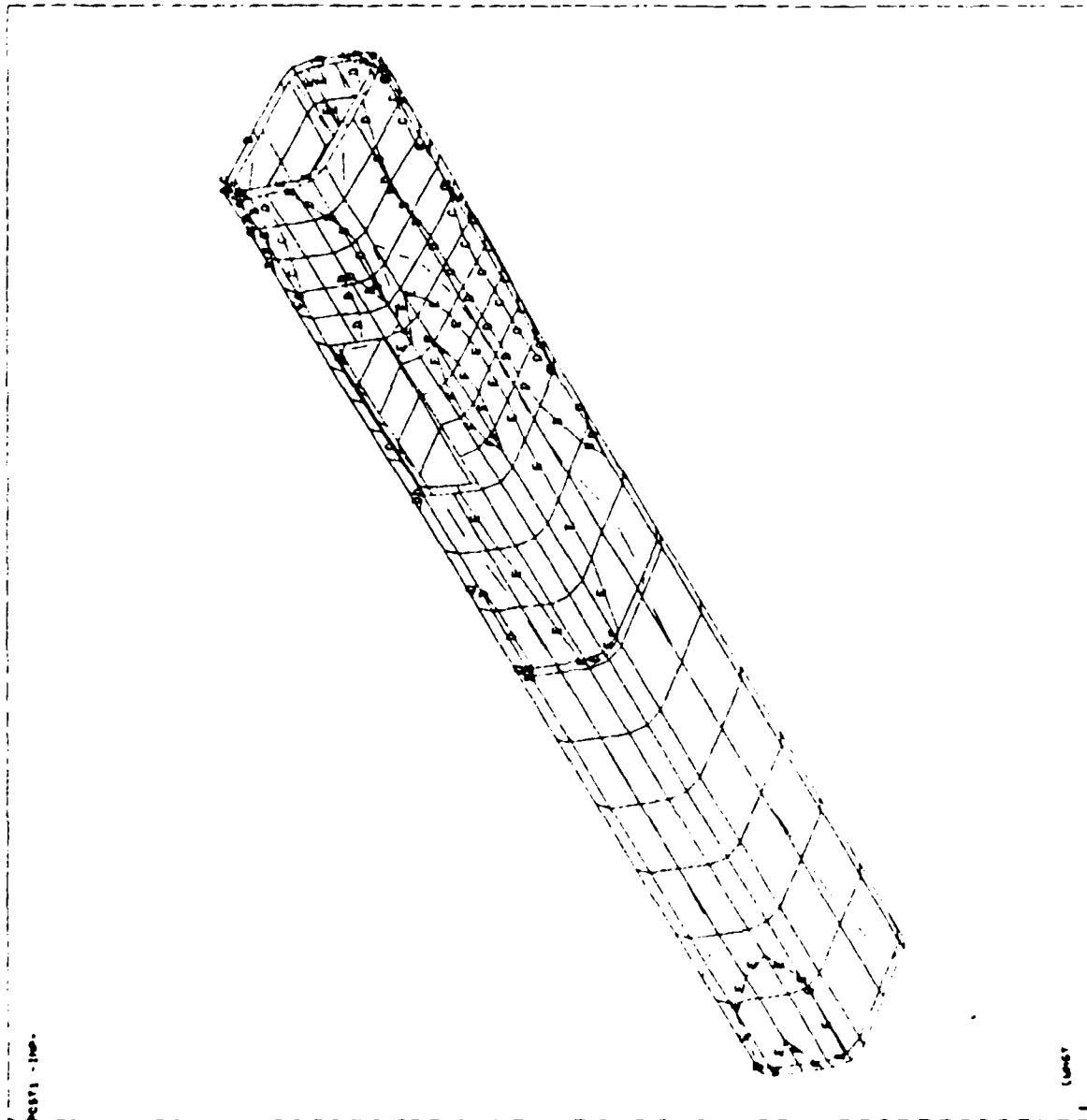
POST1 -IMP-

LUMST

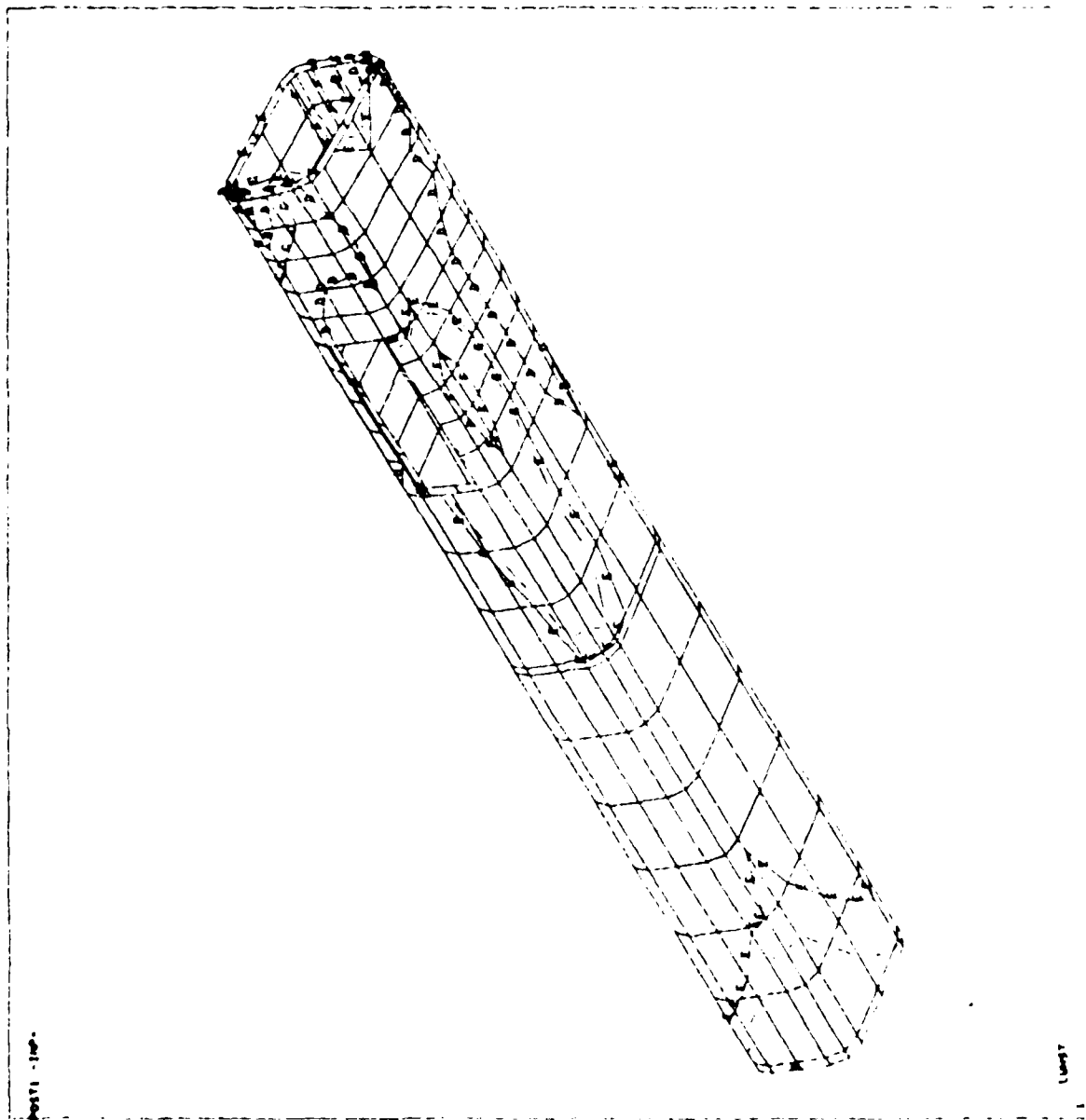
ANSYS 4.20
 DEC 4 1986
 151531.03
 POST1 STRESS
 STEP=1
 ITER=1
 SV7
 MU=-1
 VU=-1
 ZU=-1
 DIST=104
 ZF=116
 MIDEM
 PK=2586
 PK=-3333
 A=-2248
 B=-1161
 C=-374
 D=613
 E=1600



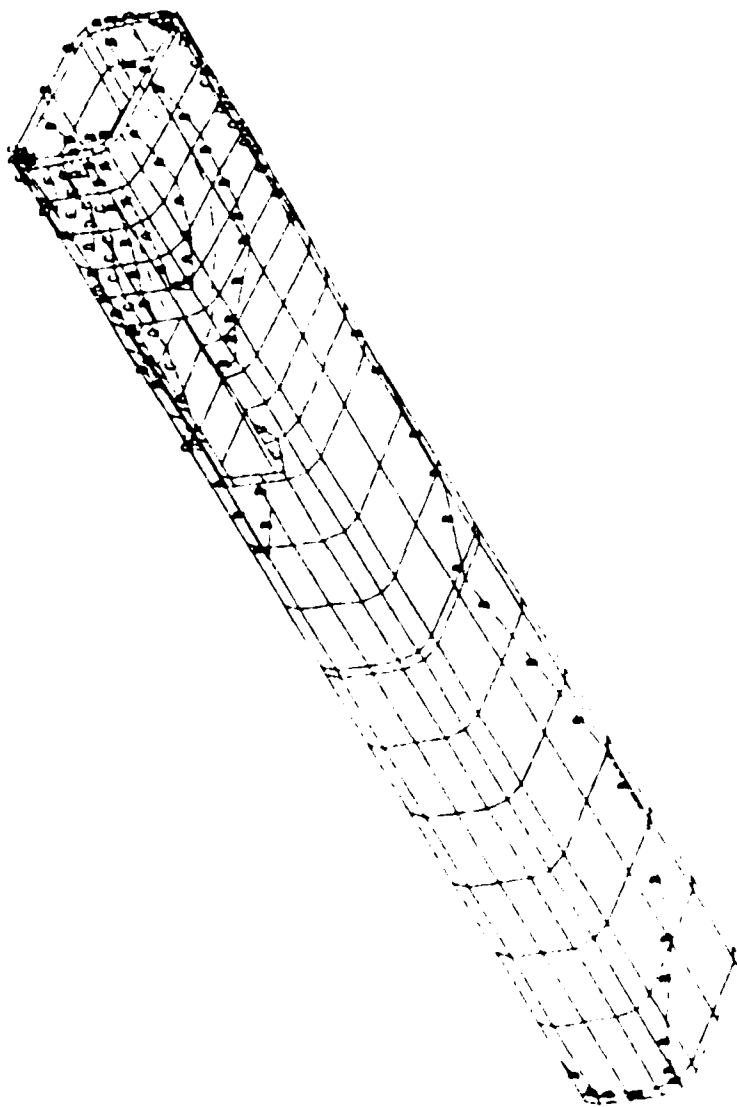
40849 4.25
 DEC 4 1966
 16/22/03
 POST1 STRESS
 STEP=1
 ITER=1
 SM7
 RU=1
 VU=1
 ZU=1
 DIST=106
 ZF=116
 MIDDLE
 MU=2361
 MU=4160
 A=3230
 B=2298
 C=1365
 D=434
 E=498
 F=1430



ANSYS 4.20
 MEC 4 1000
 10/24/11
 POST1, STRESS
 STEP=1
 ITER=1
 SUB
 NU=1
 MU=1
 ZU=1
 BIST=100
 ZF=116
 MIBCM
 RU=33202
 RM=-92220
 A=-70291
 B=-56360
 C=-30429
 D=-20400
 E=-8567
 F=-15360



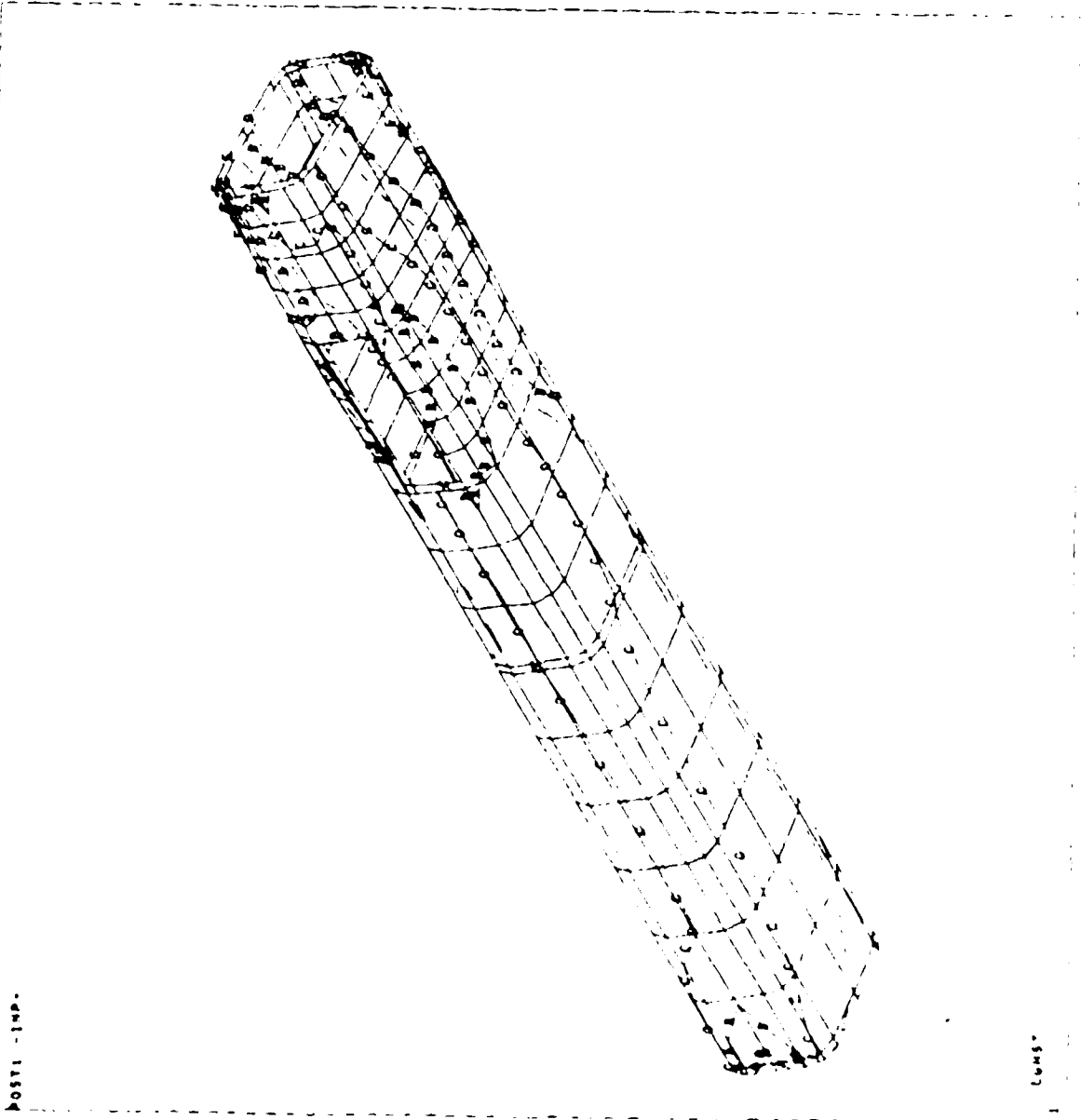
ANSYS 4.20
 DEC 4 1986
 16:28:09
 POST1 STRESS
 STEP=1
 ITER=1
 SHB
 XU=1
 YU=1
 ZU=1
 C157-104
 ZF-116
 MIDDLEM
 PK=7112
 PM=1982
 A=685
 B=615
 C=1915
 D=2215
 E=4515
 F=5815



POST1 -IMP-

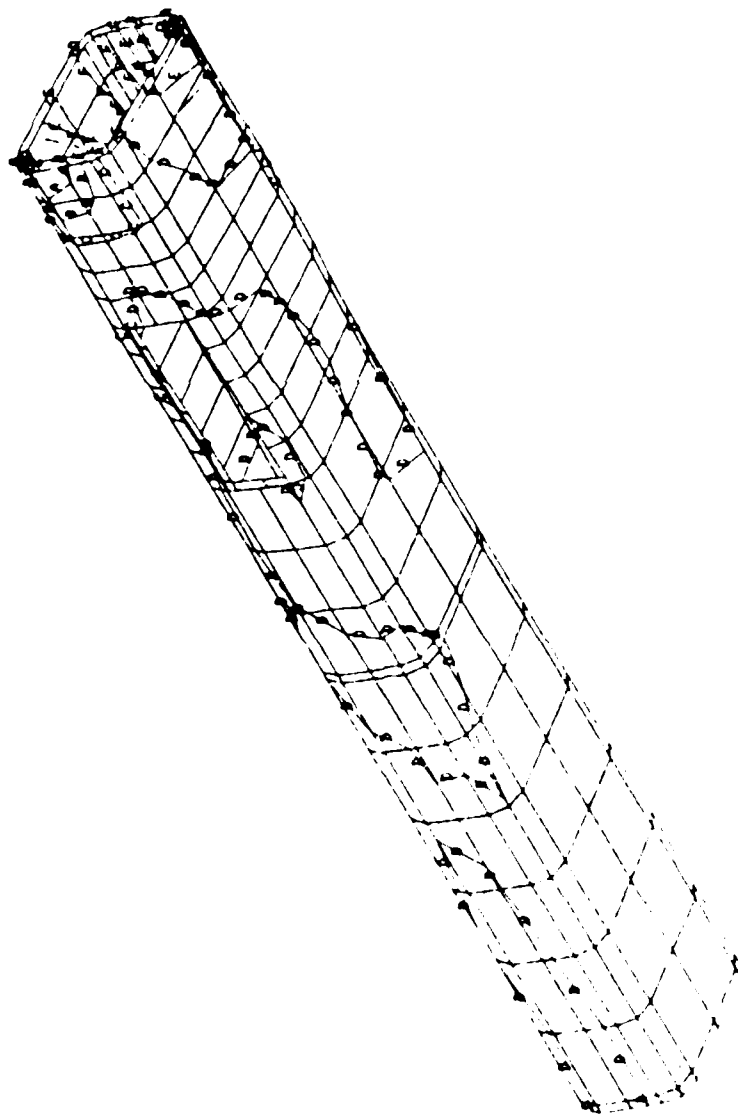
1

ANSYS 4.20
 DEC 4 1986
 16:33:38
 POST1, STRESS
 STEP=1
 TIME=1
 SDO
 KU=1
 VU=1
 ZU=1
 DIST=104
 ZF=116
 MIDDLE
 MX=50118
 MY=52086
 A=38259
 B=23529
 C=8709
 D=5931
 E=20661
 F=35331



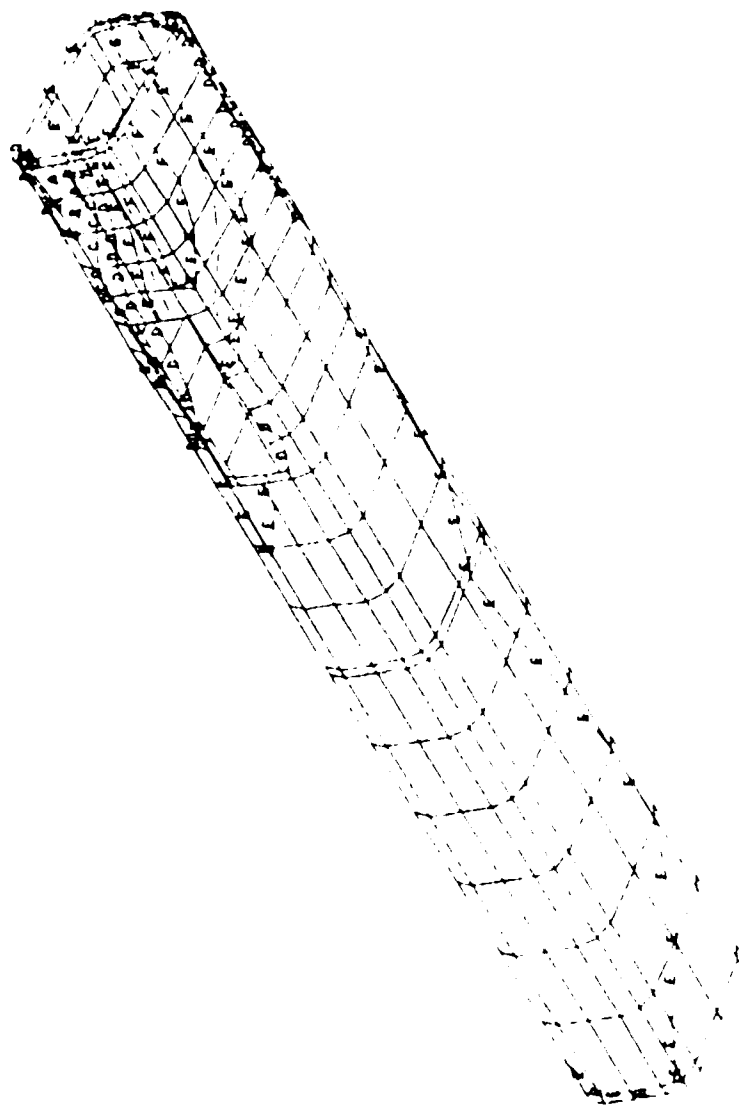
ANSYS 4.20
 DEC 4 1986
 16:35:56
 POST1 STRESS
 STEP=1
 ITER=1
 SVD
 KU=1
 VU=1
 ZU=1
 DIST=104
 ZF=116
 MIDDLE
 MX=2641
 MN=-5607
 A=-4345
 B=-3180
 C=-2015
 D=-850
 E=315
 F=1480

POST1 -IMP-



LEMS

ANSYS 4.20
 ELIC 4 1986
 16-37-46
 POST1 STRESS
 STEP=1
 ITER=1
 SMN
 KU=-1
 VU=-1
 ZU=-1
 DIST=104
 ZF=116
 MIDDEN
 M4=1987
 MN=-7891
 A=-5794
 B=-4497
 C=-3288
 D=-1983
 E=-606
 F=-691

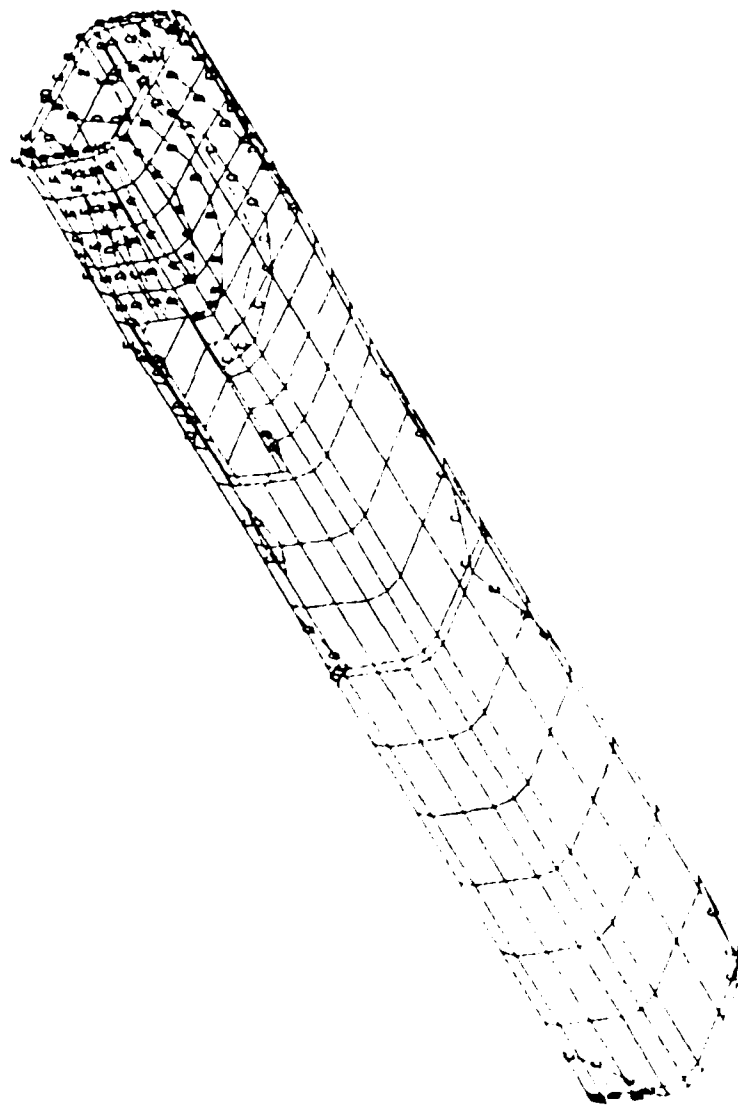


POST1 -IMP-

LUNST

AMVS 4.28
 ECC 4 1986
 16:39:36
 POST1 STRESS
 STEP=1
 ITER=1
 SH10
 KU=-1
 VU=-1
 ZU=-1
 DIST=104
 ZF=116
 MIDDEN
 MM=61867
 MM=-30202
 A=-24765
 B=-10326
 C=4113
 D=18552
 E=32991
 F=47430

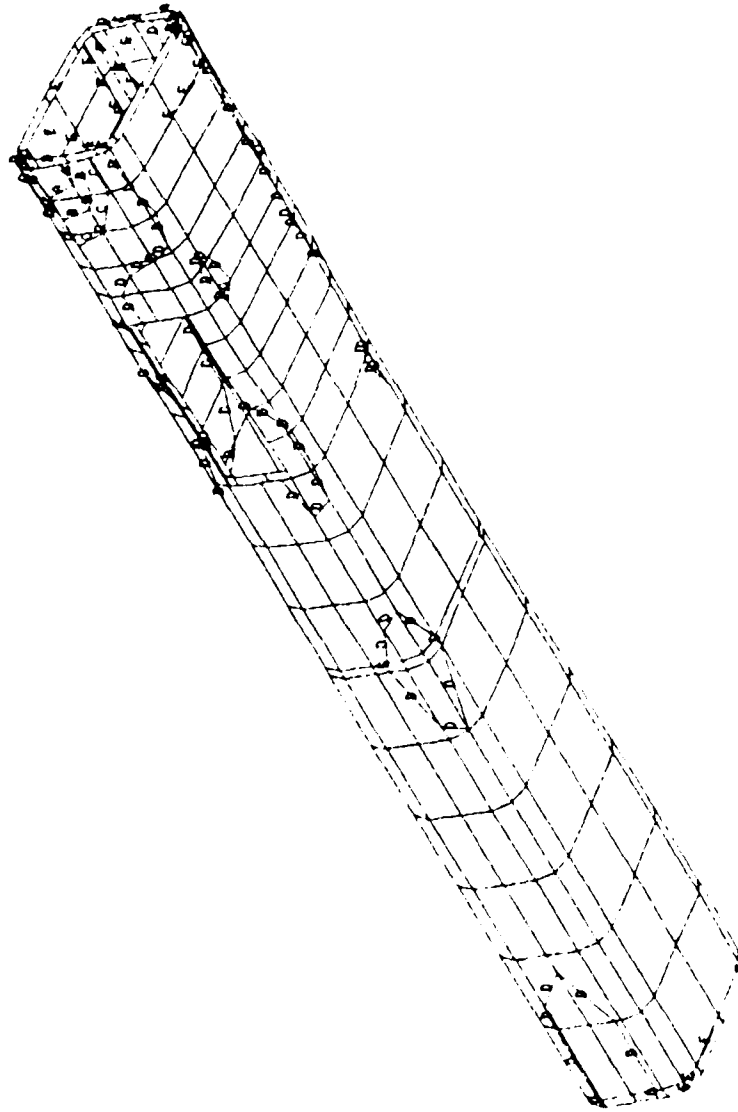
POST1 -IMP-



LWST

ANSYS 4.20
 DEC 4 1986
 1614114
 POST1 STRESS
 STEP=1
 ITEM=1
 SV10
 KU=-1
 VU=-1
 ZU=-1
 DIST=104
 ZF=116
 MIDDEN
 MK=2505
 MN=6452
 A=-5174
 B=-3804
 C=-2614
 D=-1334
 E=-53.6
 F=1226

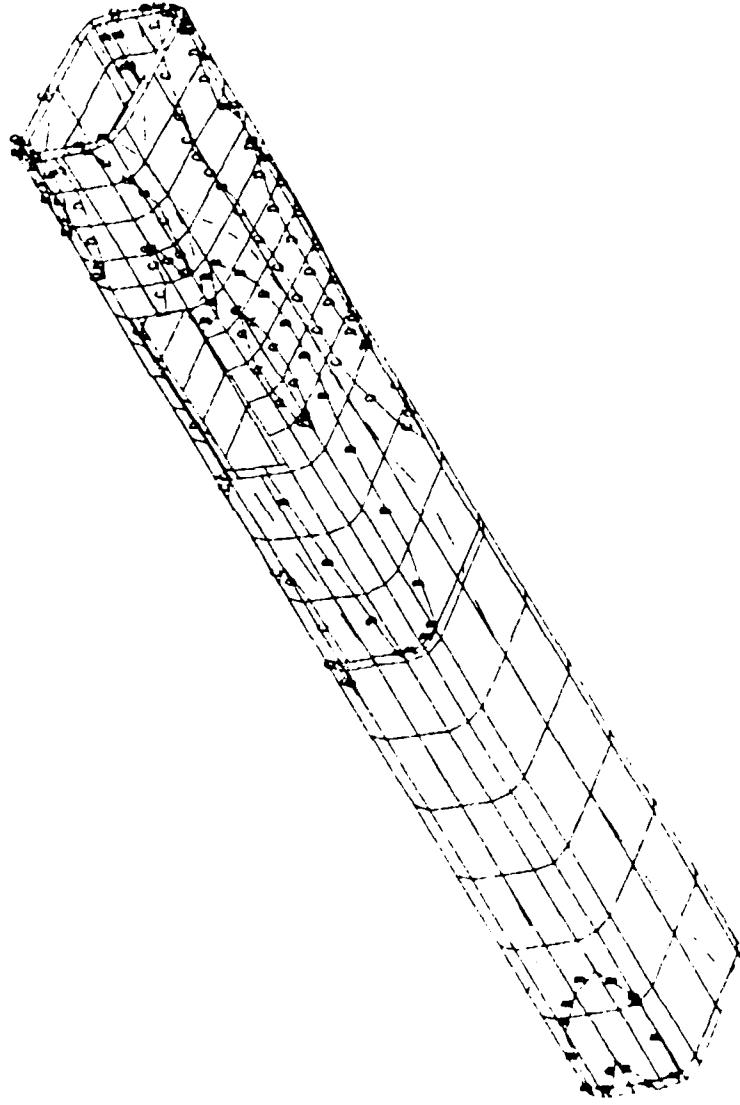
POST1 -IMP.



LMST

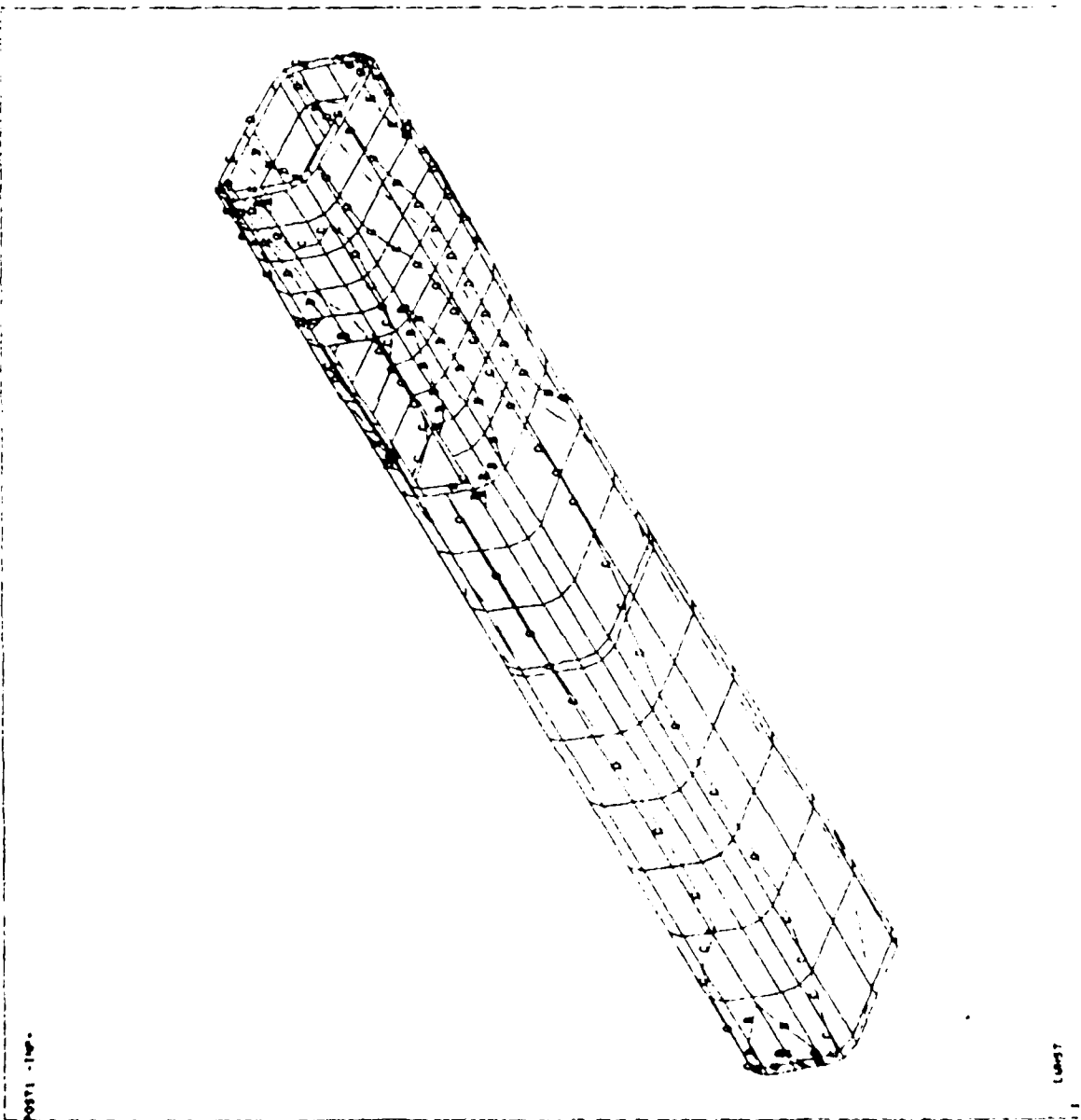
ANSYS 4.20
 DEC 4 1986
 16142145
 POST1 STRESS
 STEP=1
 ITER=1
 SM10
 XU=-1
 YU=-1
 ZU=1
 DIST=104
 ZF=116
 MIDDEN
 MX=4112
 MY=-2363
 A=-1438
 B=-513
 C=412
 D=1337
 E=2262
 F=3187

POST1 -IMP-



LU457

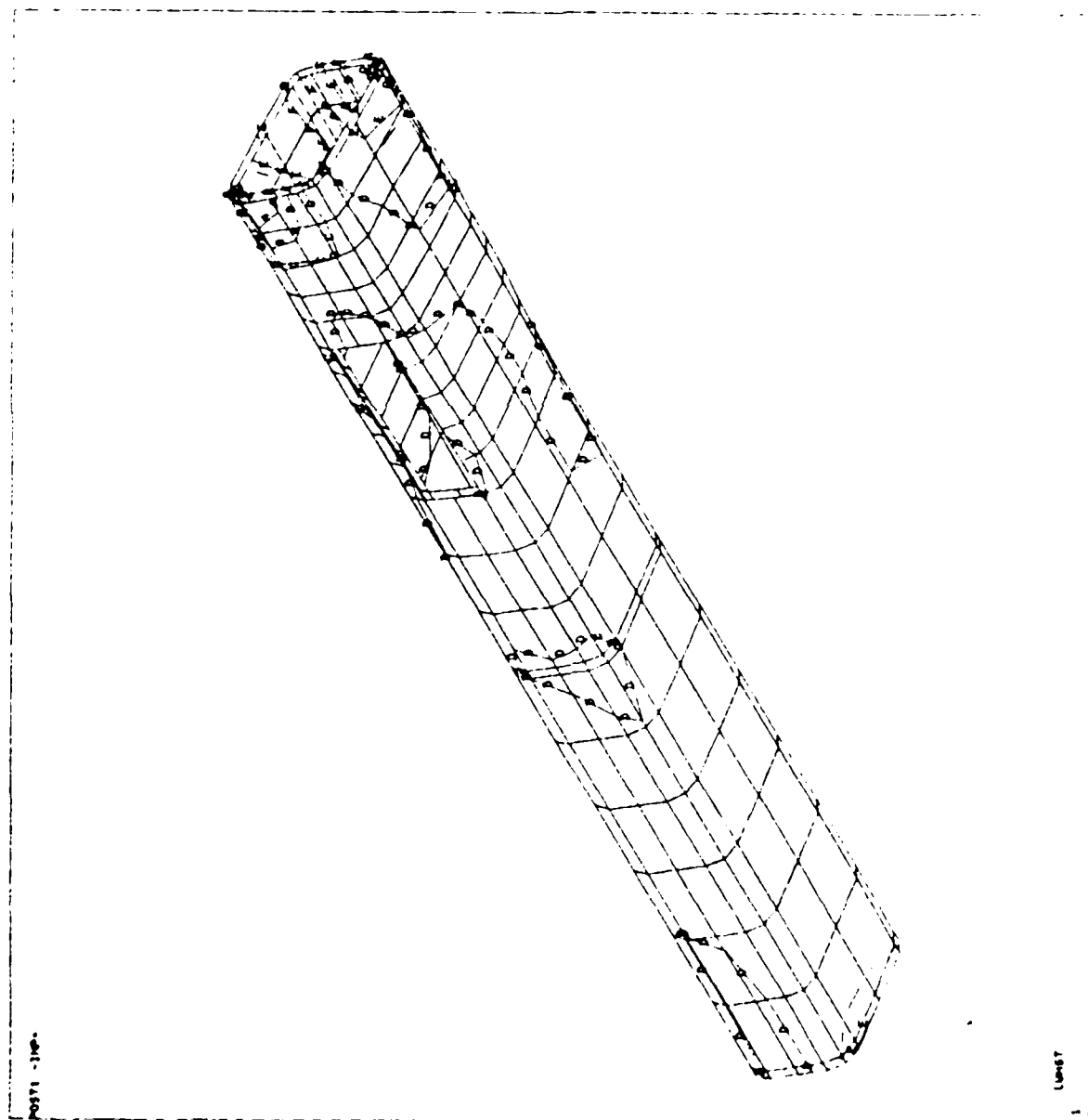
ANALYSIS 4.20
 DEC 4 1986
 17:08:56
 POST1, STRESS
 STEP=1
 ITER=1
 SALL
 MU=1
 VU=1
 ZU=1
 DIST=100
 ZF=116
 MIDDEN
 MU=49150
 MU=52057
 A=30371
 B=23784
 C=8107
 D=5300
 E=10077
 F=24564



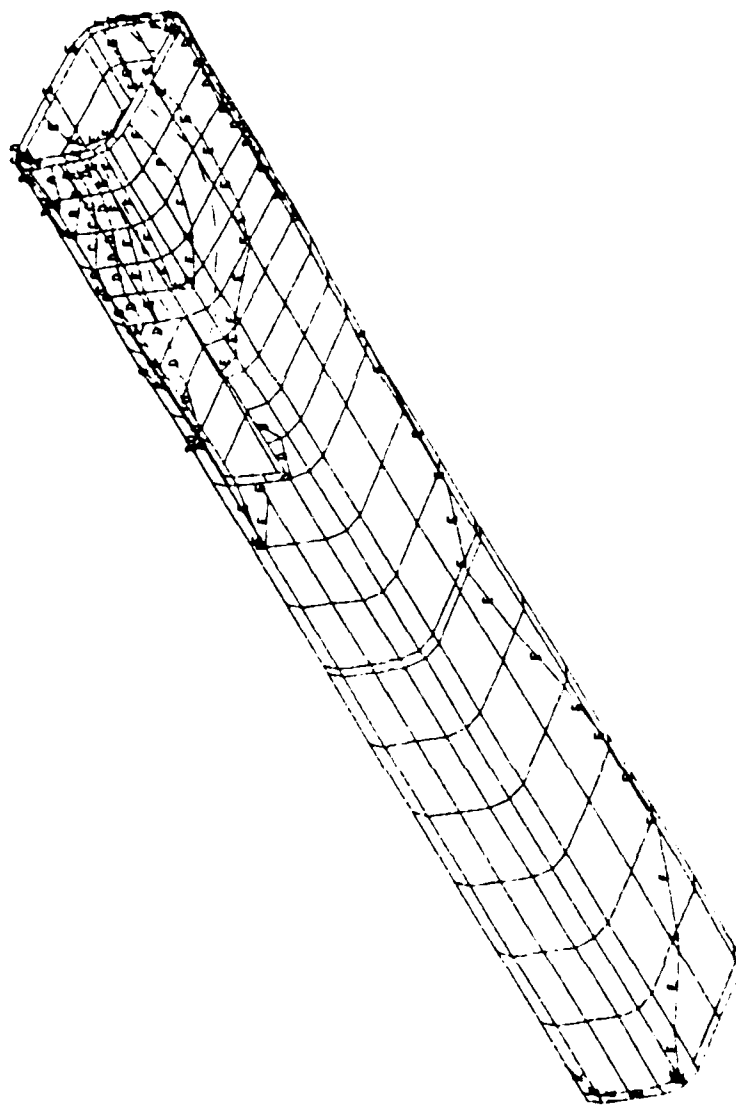
POST1 -110-

10007

1324

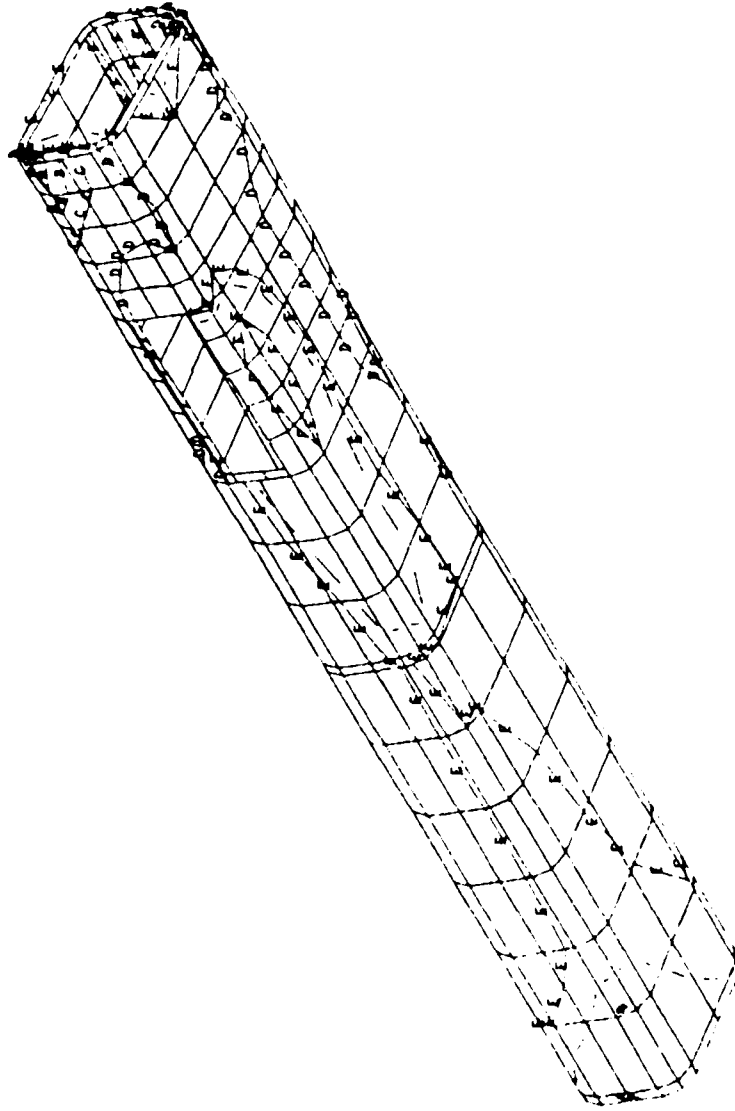


1999



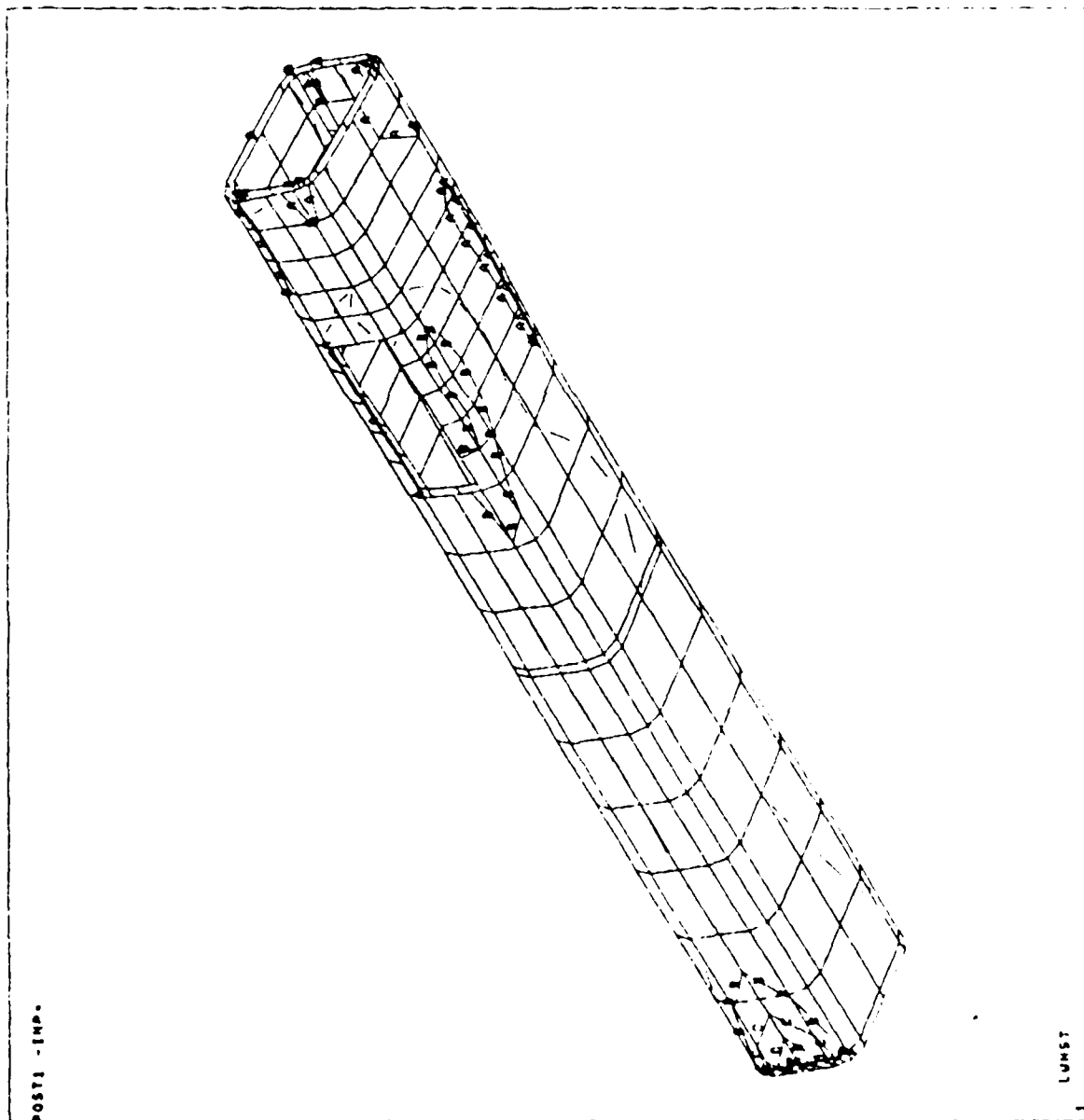
ANSYS 4.2D
 DEC 4 1986
 17:14:54
 POST1 STRESS
 STEP=1
 ITER=1
 SK12
 KU=-1
 VU=-1
 ZU=1
 DIST=104
 ZF=116
 MIDDEN
 PK=31126
 MN=92704
 A=-75014
 B=-57324
 C=-39634
 D=-21944
 E=-4254
 F=13436

POST1 -IMP-

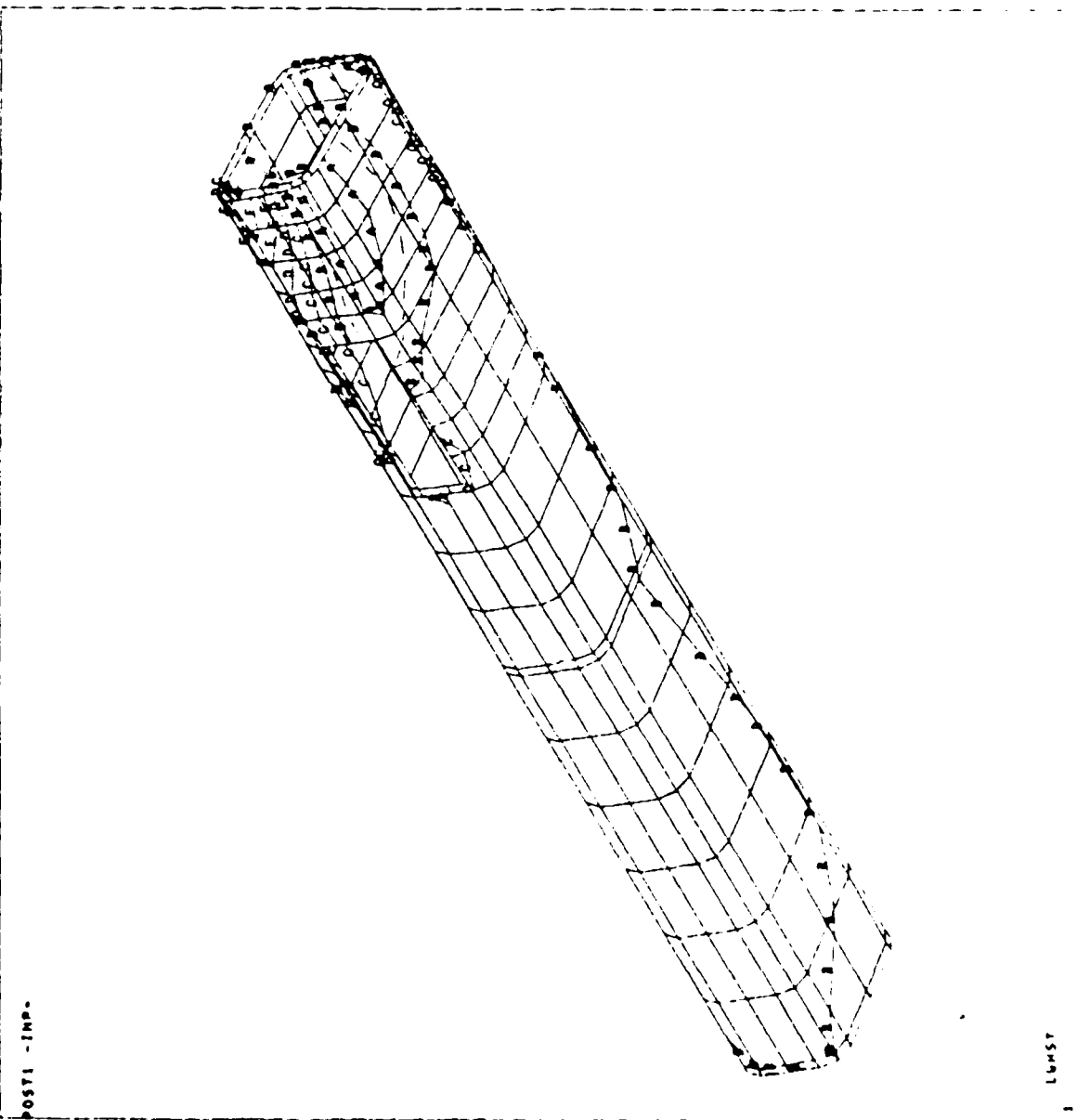


LUNST

ANSYS 4.28
 DEC 4 1986
 17:16:14
 POST1 STRESS
 STEP=1
 ITER=1
 SVL2
 KU=-1
 YU=-1
 ZU=-1
 DIST=104
 ZF=116
 MIDDEN
 WA=13981
 MM=3805
 A=1352
 B=1204
 C=3760
 D=6316
 E=8872
 F=11428

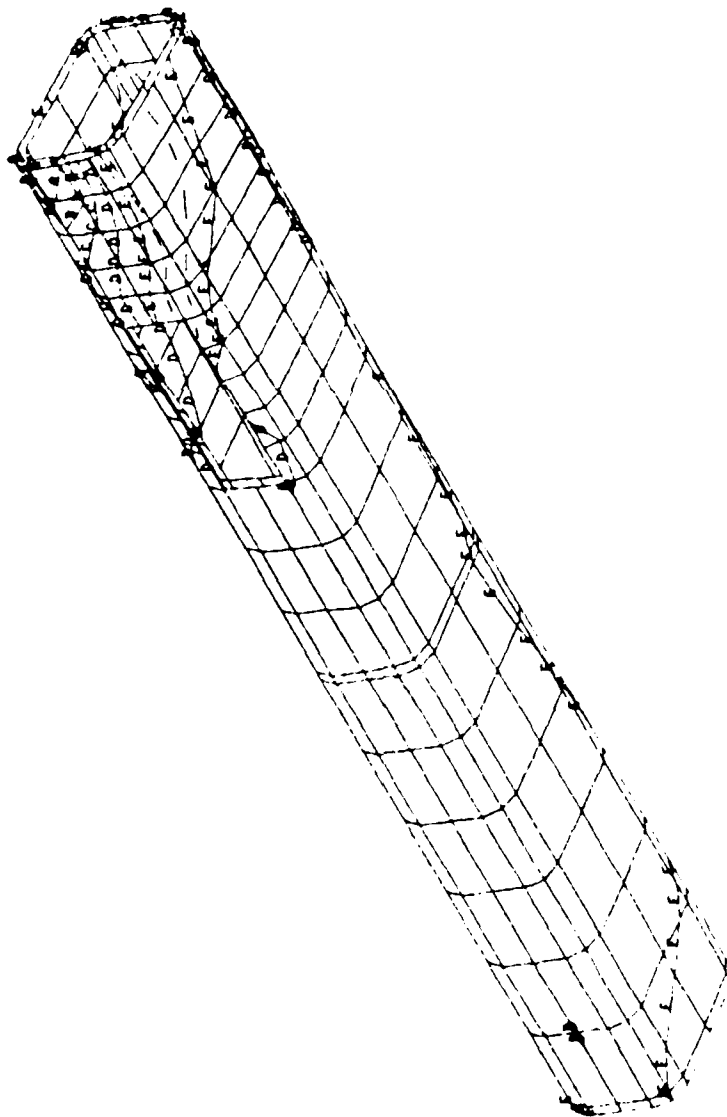


ANSYS 4.20
 DEC 4 1986
 17:17:30
 POST1 STRESS
 STEP=1
 LAYER=1
 SM12
 KU=1
 VU=1
 ZU=1
 DIST=104
 ZF=116
 MIDDLE
 MX=7028
 MY=2004
 A=716
 B=575
 C=1866
 D=3157
 E=4448
 F=5739



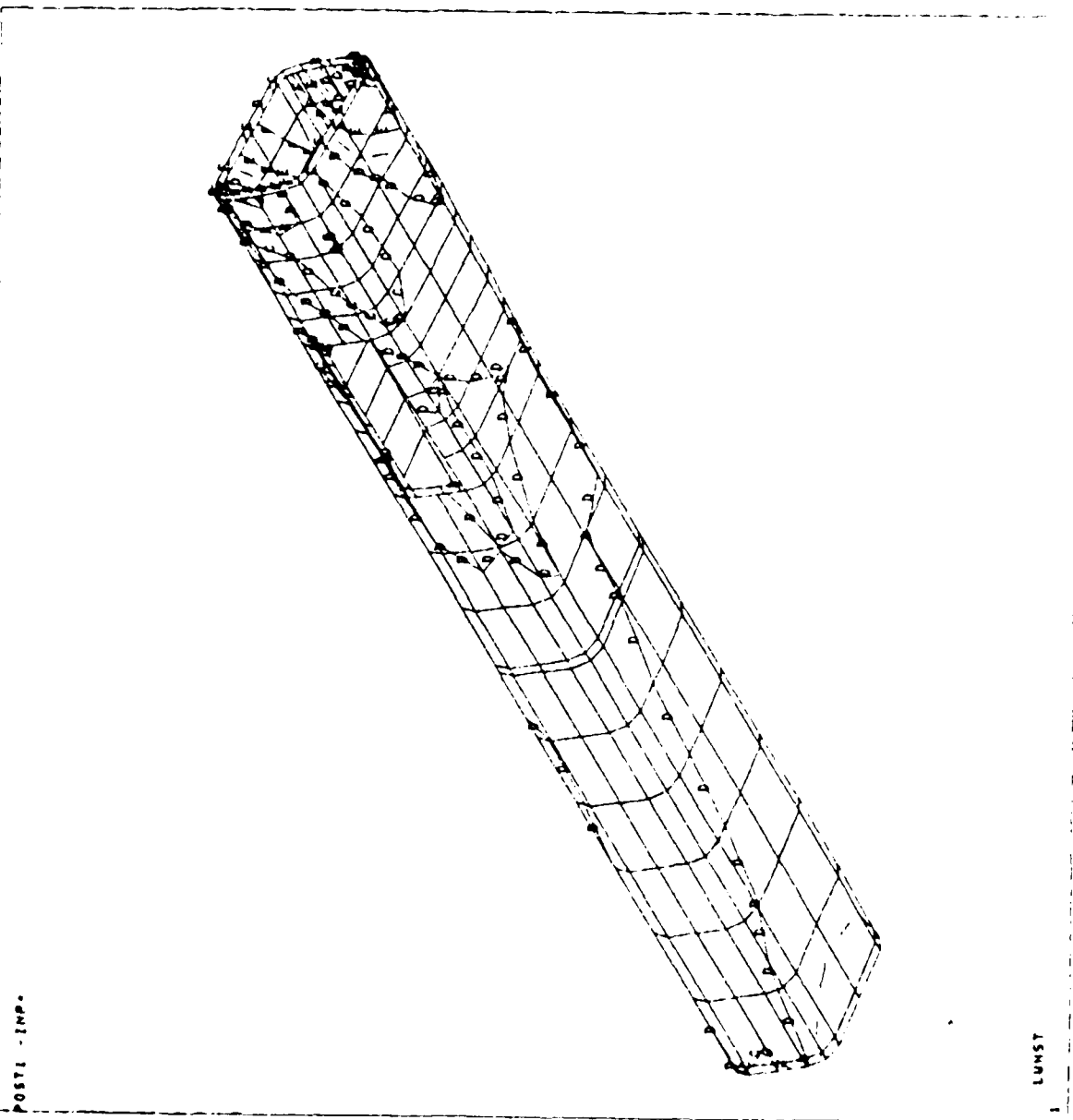
ANSYS 4.20
 DEC 4 1986
 17:19:11
 POST1 STRESS
 STEP=1
 ITER=1
 S413
 KU=1
 VU=1
 ZU=1
 DIST=104
 ZF=116
 MIDDLE
 RN=44517
 RM=144755
 P=117217
 B=90678
 C=63039
 D=36600
 E=9561
 F=17478

POST1 -IMP.



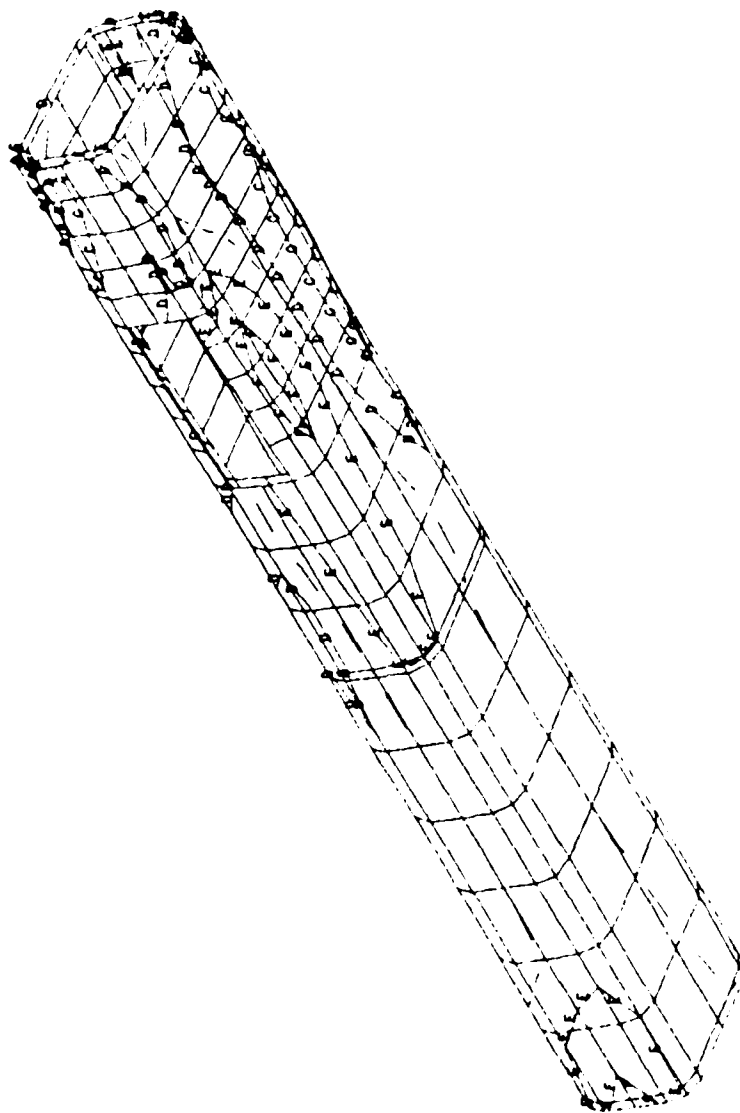
LUMST

ANSYS 4.28
 DEC 4 1986
 17:20:37
 POST1, STRESS
 STEP=1
 ITER=1
 SVI,3
 RV=-1
 VU=-1
 ZU=1
 DIST=104
 ZF=116
 MIDDLE
 MA=2164
 MN=-3896
 A=-2031
 B=-2165
 C=-1299
 D=-433
 E=433
 F=1299



ANSYS 4.20
 DEC 4 1986
 17:22:00
 POST1, STRESS
 STEP=1
 ITER=1
 SM13
 KU=1
 VU=1
 ZU=1
 DIST=104
 ZF=116
 MIDDLE
 MX=2365
 MY=4064
 A=3147
 B=2828
 C=1309
 D=390
 E=520
 F=1448

POST1 -IMP-

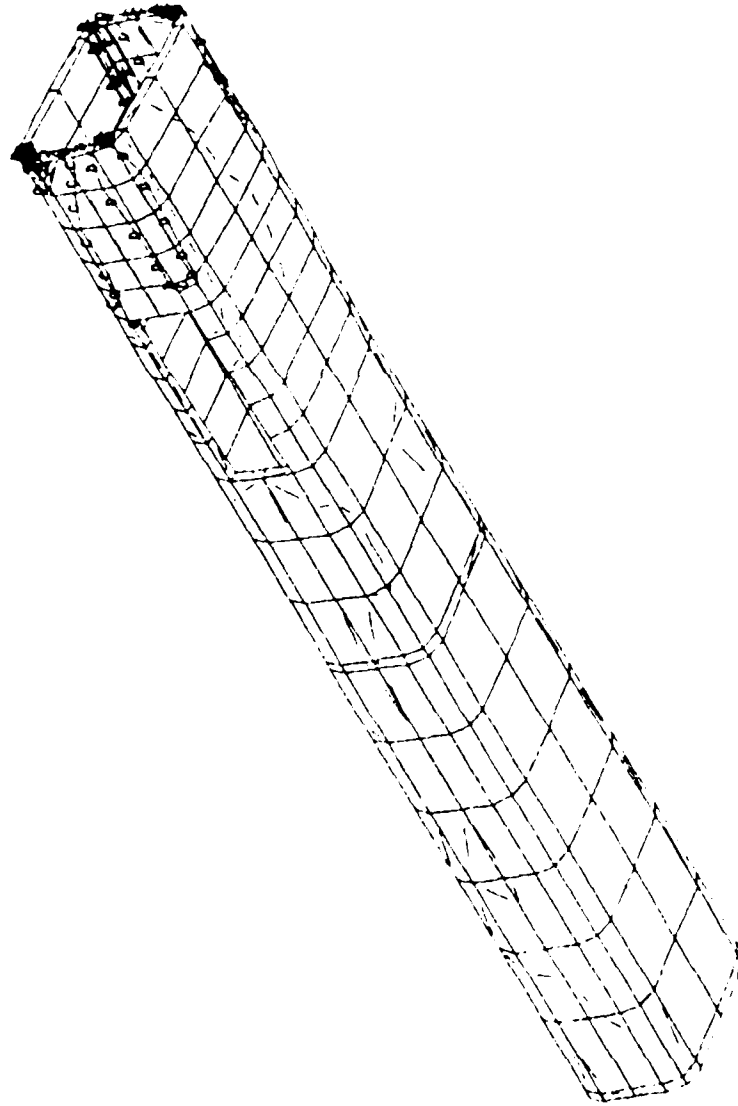


LUMST

ANSYS 4.28
 DEC 4 1986
 17:24:34
 POST1 STRESS
 STEP=1
 ITER=1
 SK
 BOTTOM
 STRESS ELEM CS
 KV=-1
 VU=-1
 ZU=1
 DIST=104
 ZF=116
 MIDDLEM
 RX=342
 RN=-326
 A=-232
 B=-136
 C=-40
 D=56
 E=152
 F=248

LORE

POST1 -IMP-



LUMST

ANSYS 4.20
DEC 4 1986
17128152

POST1 STRESS

STEP=1

ITER=1

SVZ

TOP

STRESS ELEM CS

KU=-1

VU=-1

ZU=-1

DIST=104

ZF=116

MIDLEN

MX=80.2

MY=52.2

A=-58.5

B=-43.5

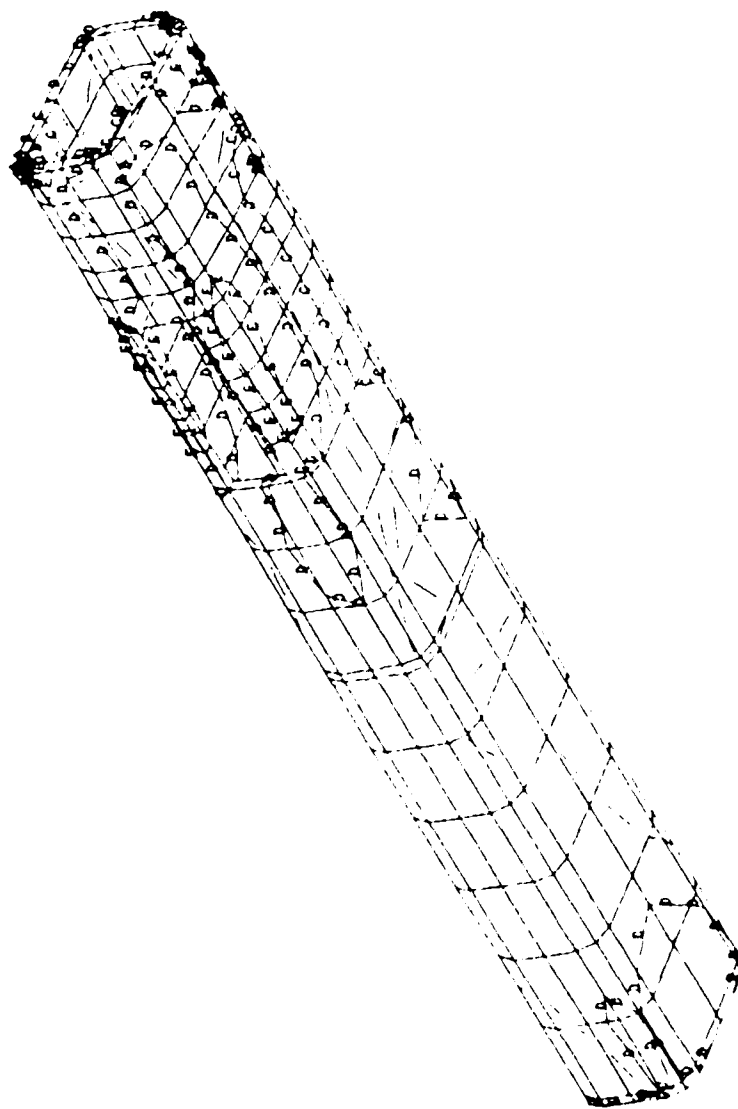
C=-18.5

D=6.52

E=31.5

F=56.5

POST1 -1ND-



LUMST

D2/380

CEL MEMO: DECEMBER 16, 1986

AD-A183 992

LIGHTWEIGHT TOWED HOWITZER DEMONSTRATOR PHASE 1 AND
PARTIAL PHASE 2 VOLUM (U) FMC CORP MINNEAPOLIS MINN
NORTHERN ORDNANCE DIV R RATHE ET AL APR 87

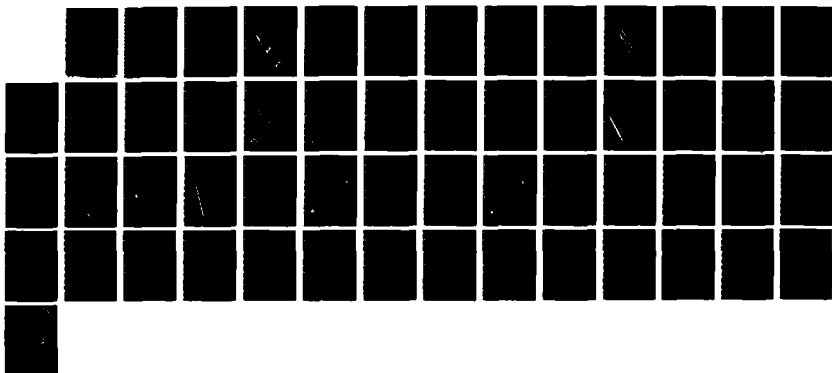
4/4

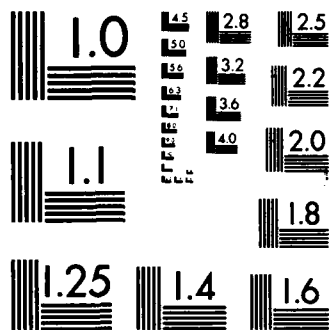
UNCLASSIFIED

FMC-E-3041-VOL-D2-PT-4 DAAA21-86-C-0047

F/G 19/6

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

FMC Central Engineering Laboratories
Santa Clara

Interoffice

To L. Liebhardt*

From C. R. Ortloff

Subject ELEMENT AND NODE PRINTOUT FOR THE 14 NOV 86
VERSION OF THE COMPOSITE CRADLE

Date Dec. 16, 1986

cc E. Thuse
J. Ries
A. Amberg
B. Zierwick
R. Kazares
R. Rathe

*one copy of printout
and original figures

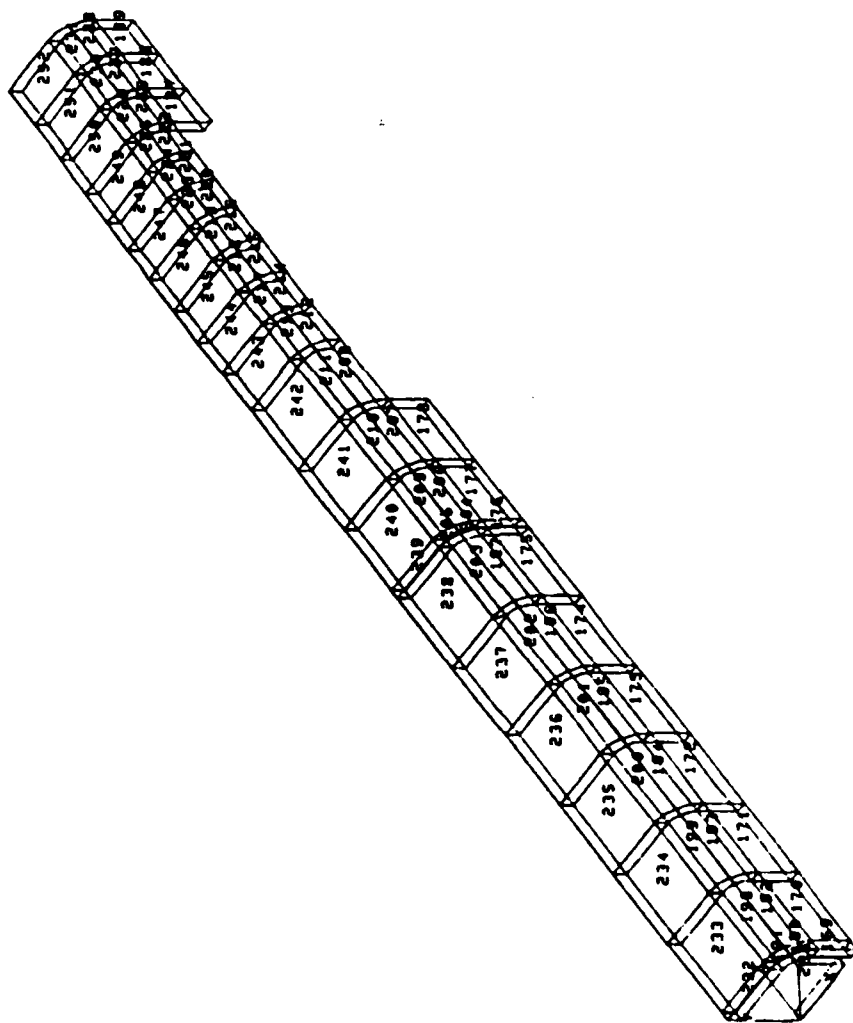
144-192

Attached is the element, node, stress and strain printout for the 14 Nov 86 version of the composite cradle. The attached figures 144-192 are consistent with the stress results reported in the 8 Dec 86 memo (CRO to R. Rathe, figures 82-143). An element printout (figures 179-192) is attached also to aid the location of the elements by nodal position. Zoomed diagrams of both element and node numbers are included also for the 20-node solids and 8-node composite elements. Printout explanation is given in ANSYS manual V.I, II for each stif value; additional explanation of contour plot averaging methods is given in V. II, p. 6.0.5-6.

CRO
C. R. Ortloff

ANSYS 4.2B
DEC 15 1986
15158155
PREP7 ELEMENTS

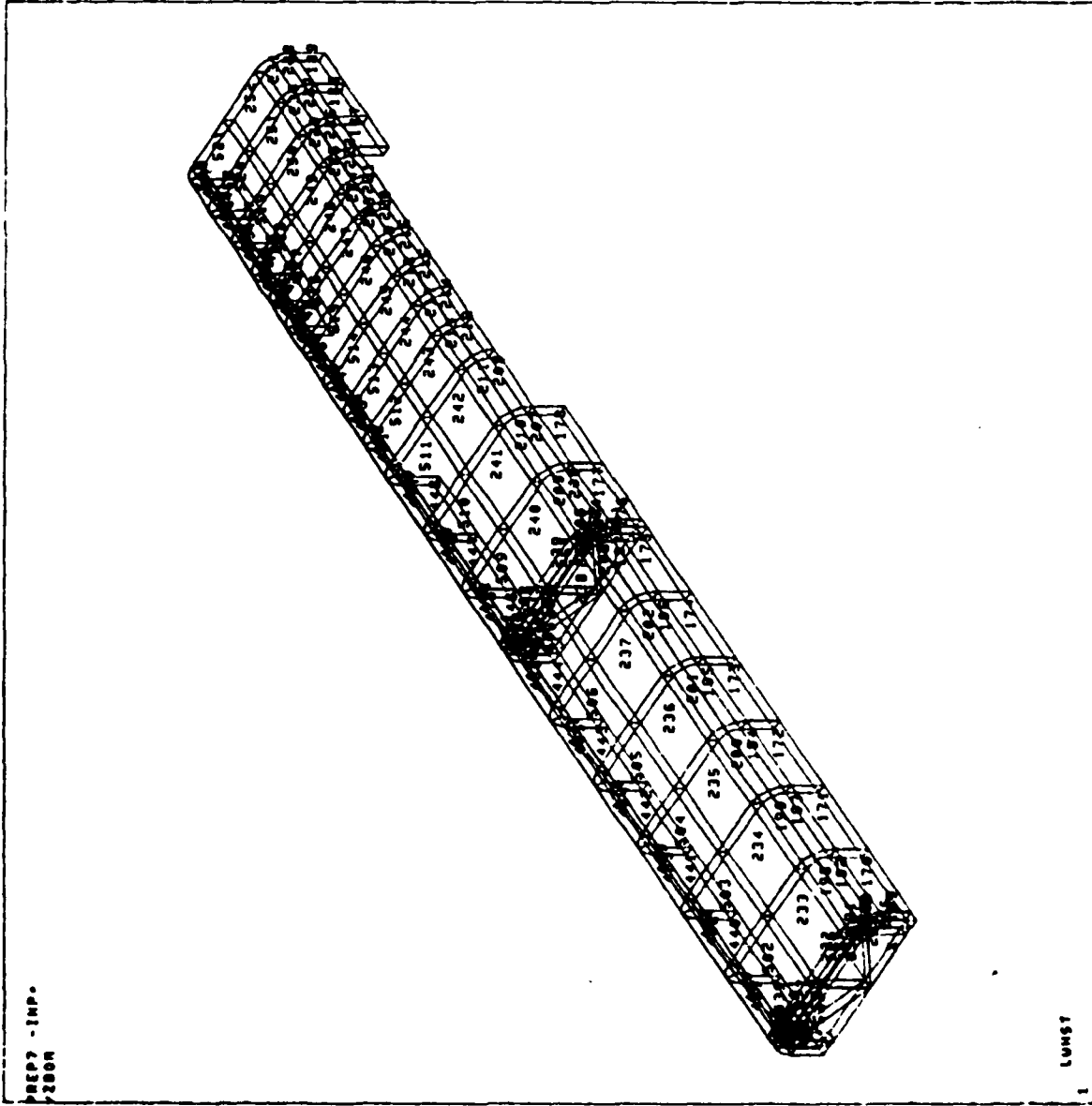
CORE



ANSYS 4.20
DEC 15 1986
16140150
PREP7 ELEMENTS
ENUN-1

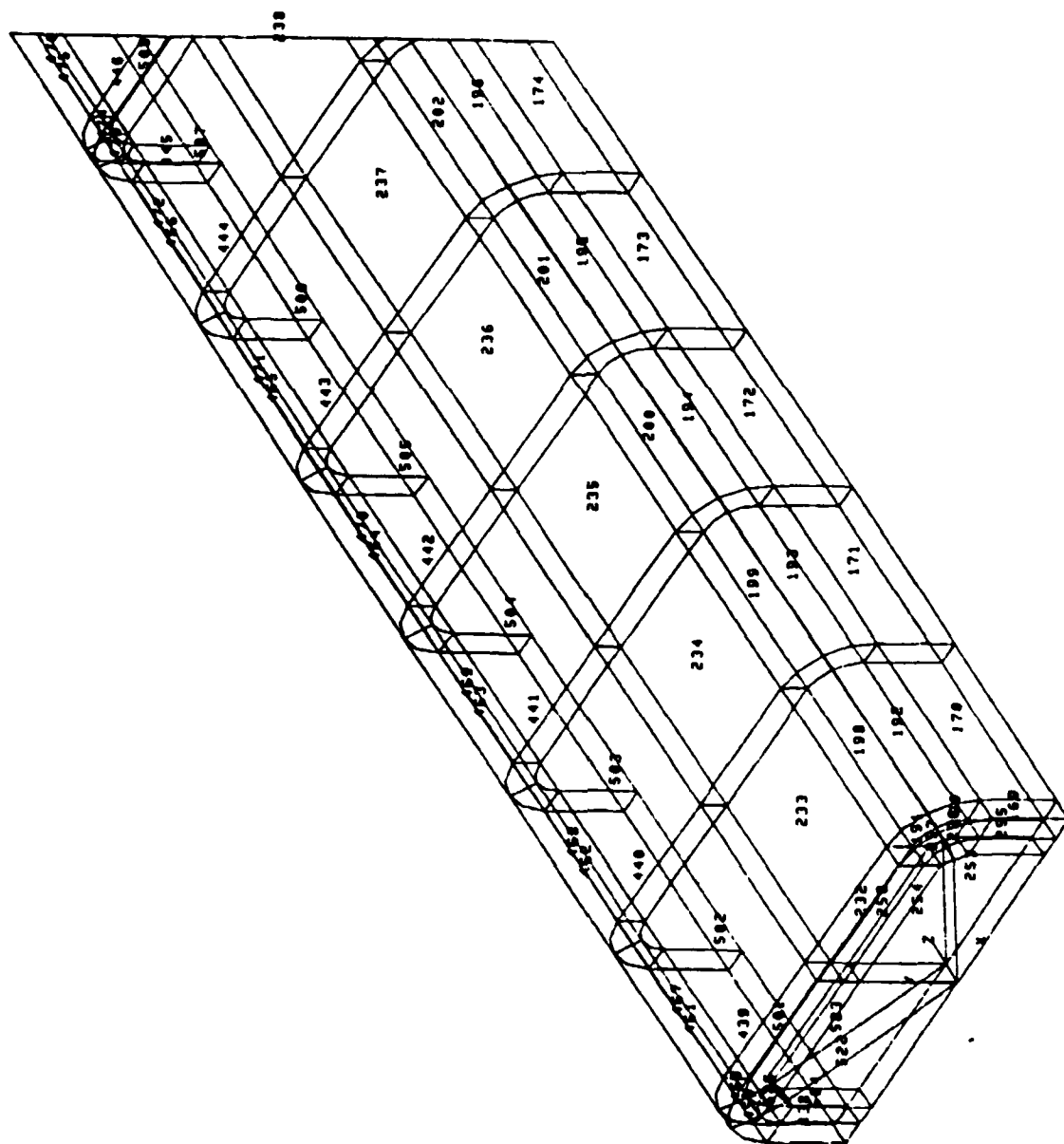
ZOOM
XU--1
YU--1
ZU--1
DIST-104
XF--1.73
YF-4.50
ZF-116
VETO-1.18

CORE



ANSYS 4.20
DEC 15 1986
16130153
PREP7 ELEMENTS

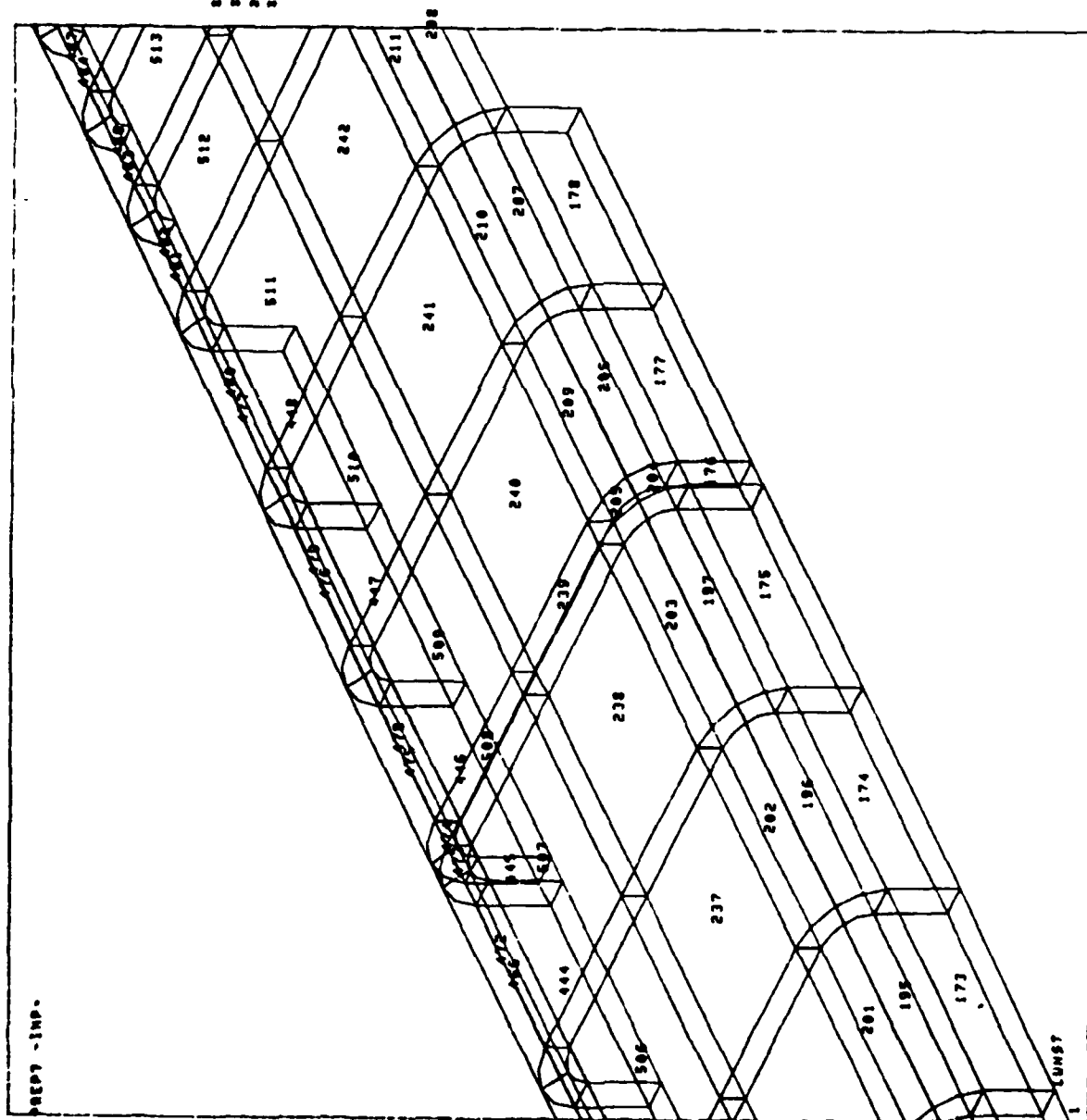
CORE



ANSYS 4.28
 DEC 15 1986
 16143140
 PREP7 ELEMENTS
 (NUM=1)

CORE

ZOOM
 KU=-1
 VU=-1
 ZU=1
 2 DIST=45.3
 2 XF=-.179
 2 YF=4.92
 2 ZF=115
 XRT0=1.38
 YRT0=1.18



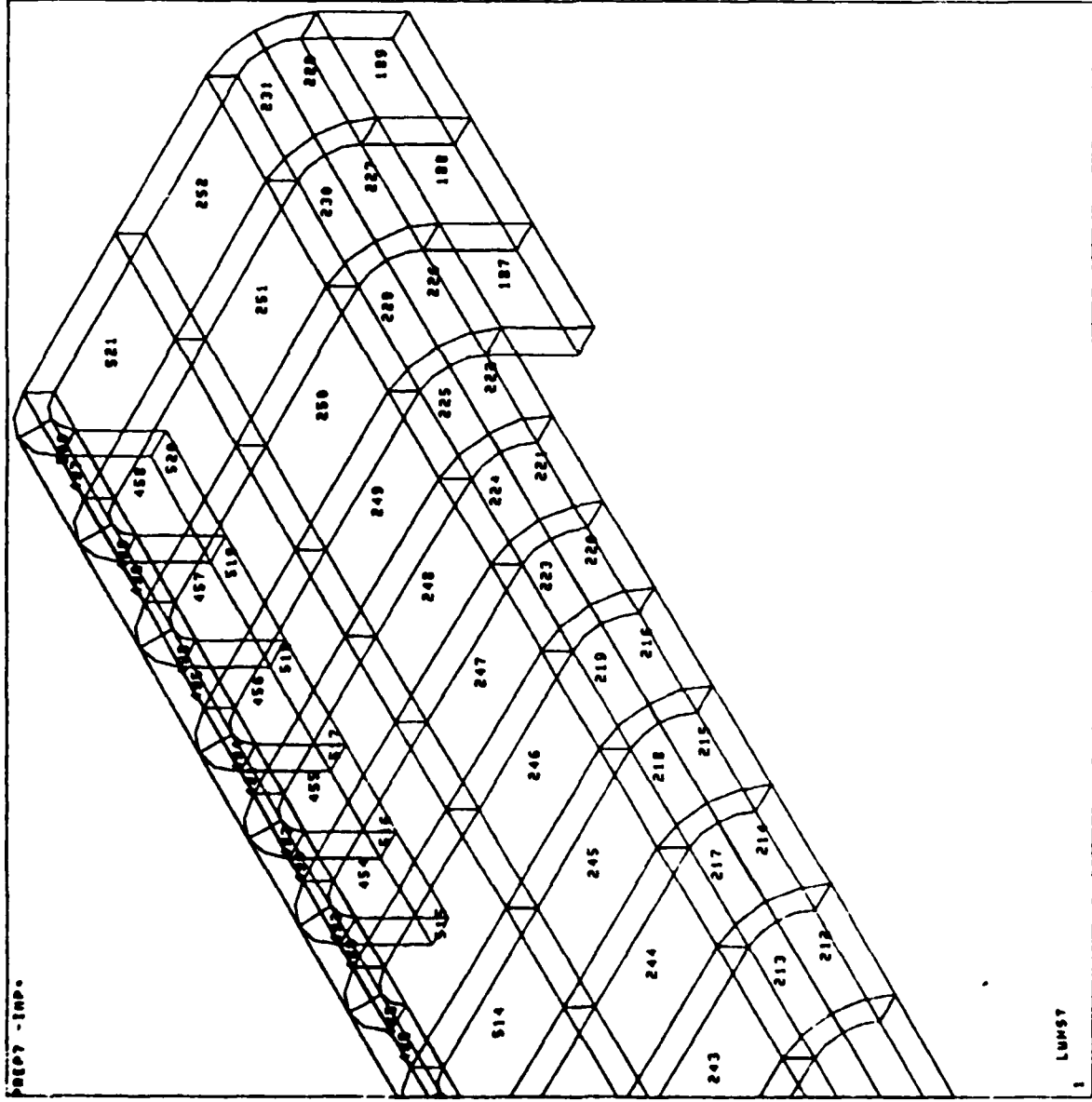
PREP7 -IMP.

1 CUNST

ANSYS 4.20
 DEC 15 1986
 18144120
 PREP7 ELEMENTS
 EMU=1

CORE

ZOOR
 XU=-1
 YU=-1
 VU=1
 1 DIST=43.2
 2 KF=33.5
 3 VF=27.5
 4 ZF=173
 KATO=1.38
 VATO=1.41



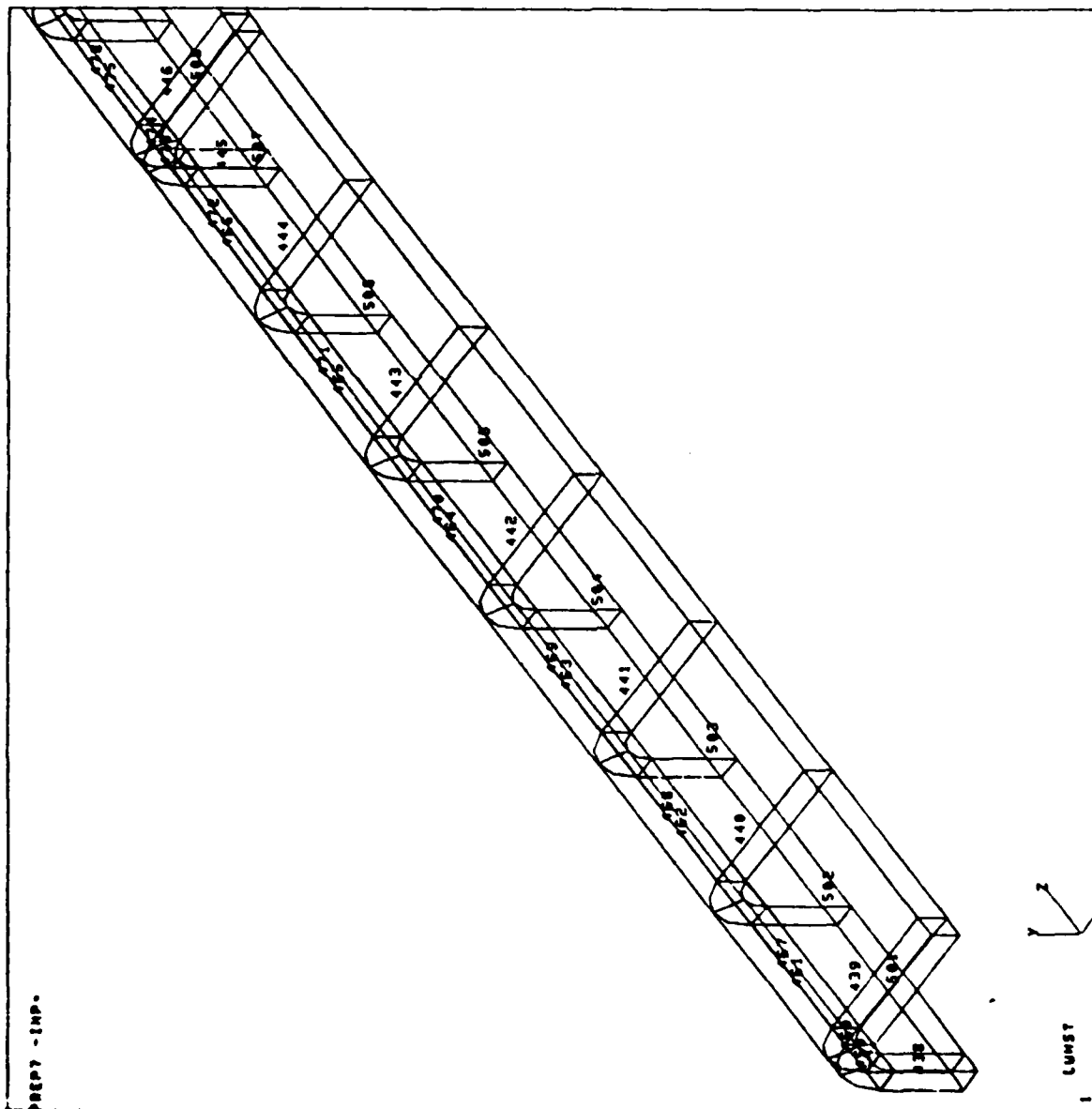
PREP7 -IMP.

LMMS7

ANSYS 4.2B
 DEC 15 1986
 15109136
 PREP7 ELEMENTS
 ENUR=1

CORE

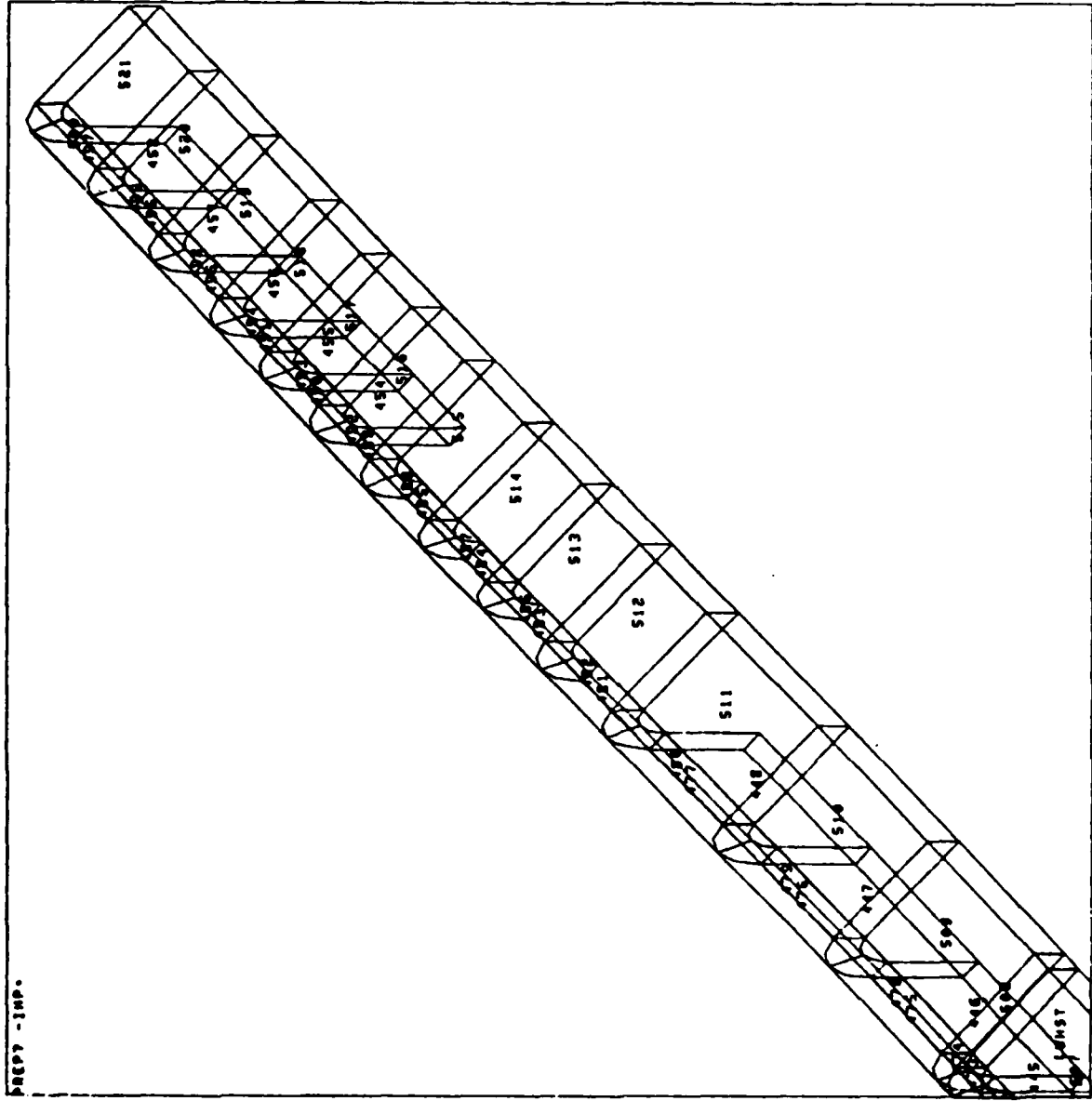
ZOOM
 XU=-1
 YU=-1
 ZU=1
 DIST=53.4
 XF=30.2
 YF=12
 ZF=73.6
 KATO=1.18
 VRT0=1.58



CORE

ANSYS 4.20
DEC 15 1986
16:10:08
PREP7 ELEMENTS
ENUR=1

ZOOM
XU=-1
YU=-1
ZU=1
SLIST=50.8
SF=7.84
VF=25.8
ZF=182
MTO=1.18
MTO=1.96

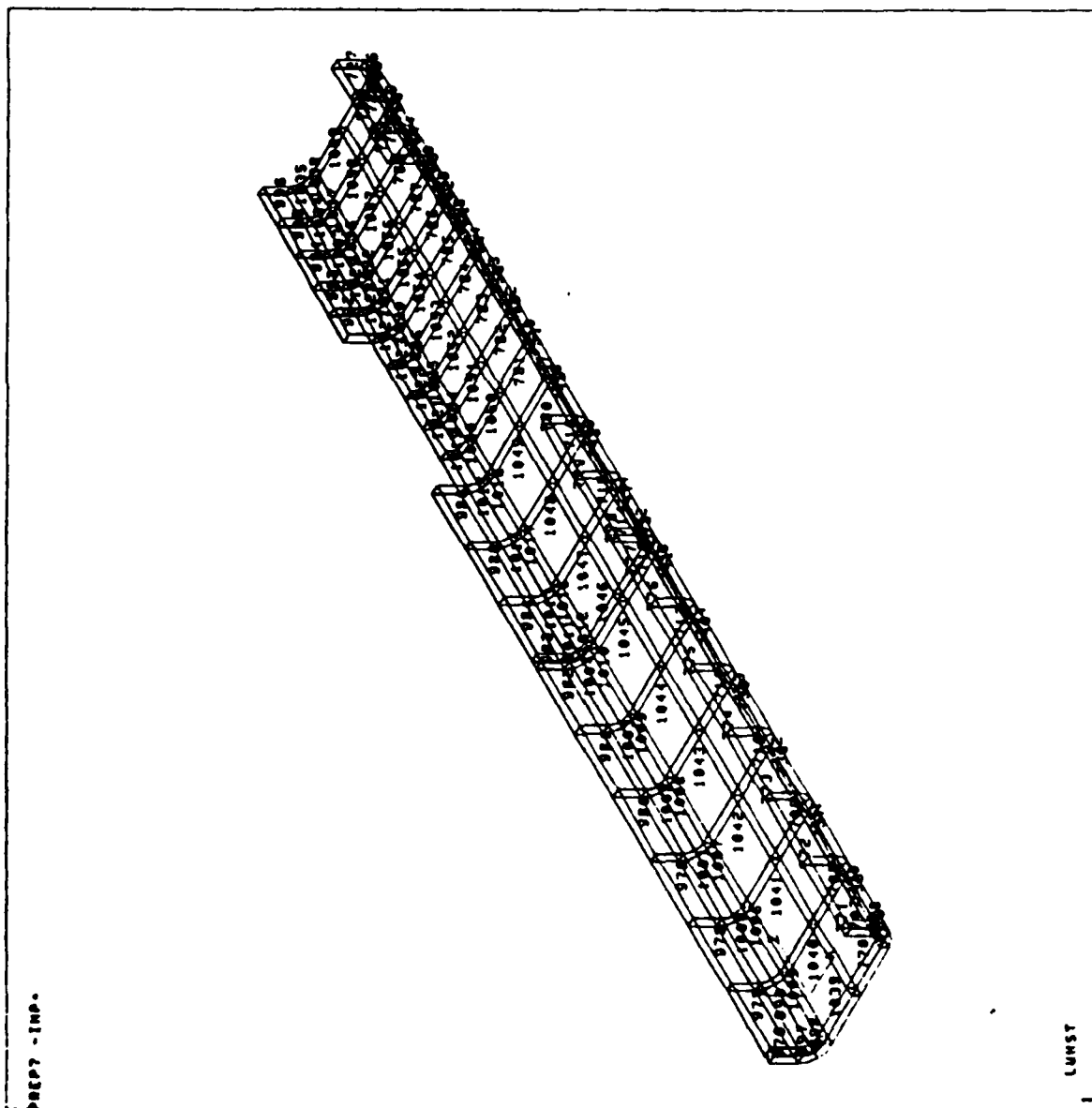


PREP7 -IMP.

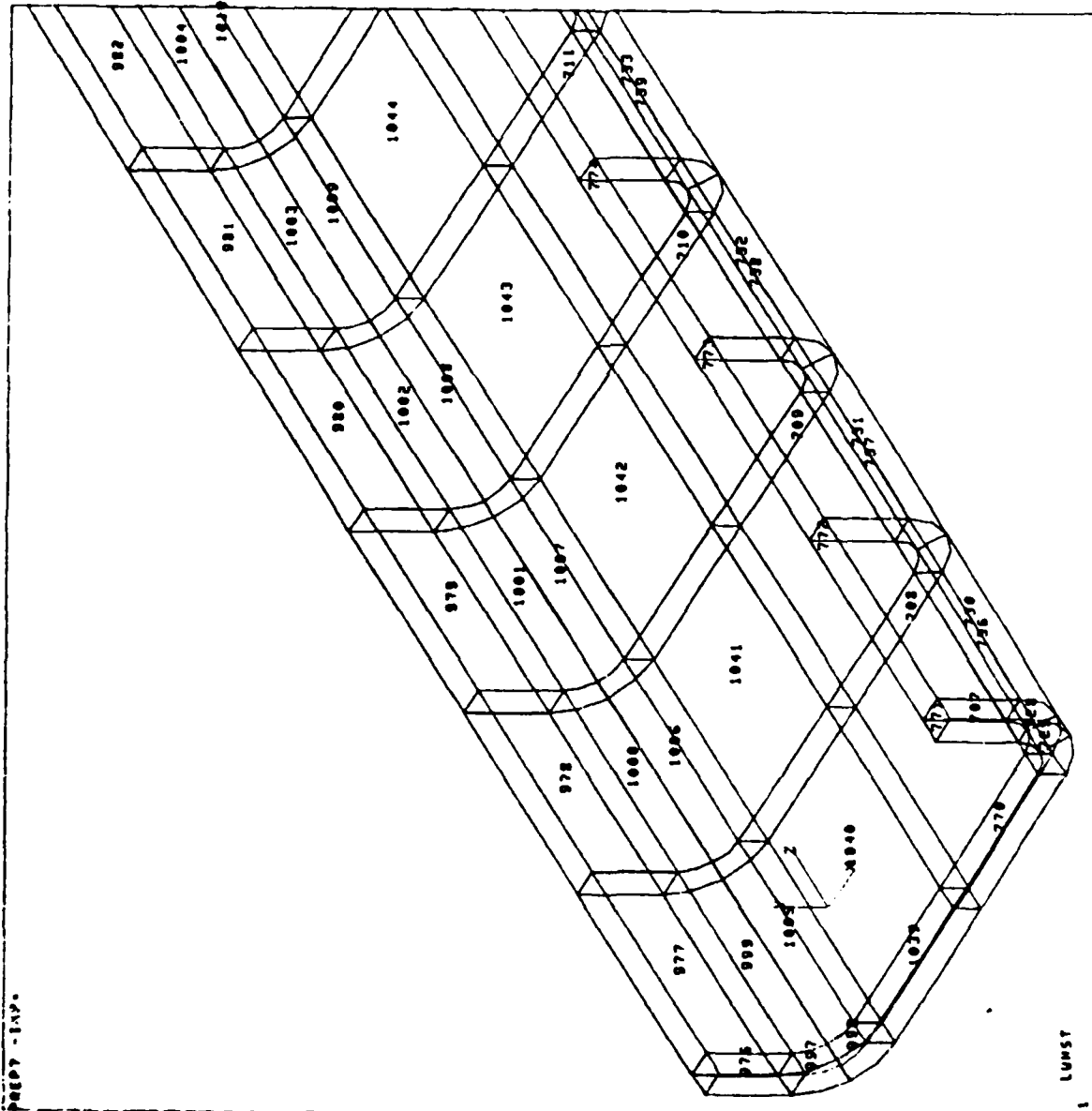
ANSYS 4.28
DEC 15 1986
161531.37
PREP7 ELEMENTS
EMUR-1

ZOOM
XU--1
YU--1
ZU--1
* DIST=143
* ZF=116
* XRT0=1.38
* YRT0=1.41

CORE



PREP7 - 1AP.



ANVS 4.20
DEC 15 1986
16153137
PREPT ELEMENTS
ENUM=1

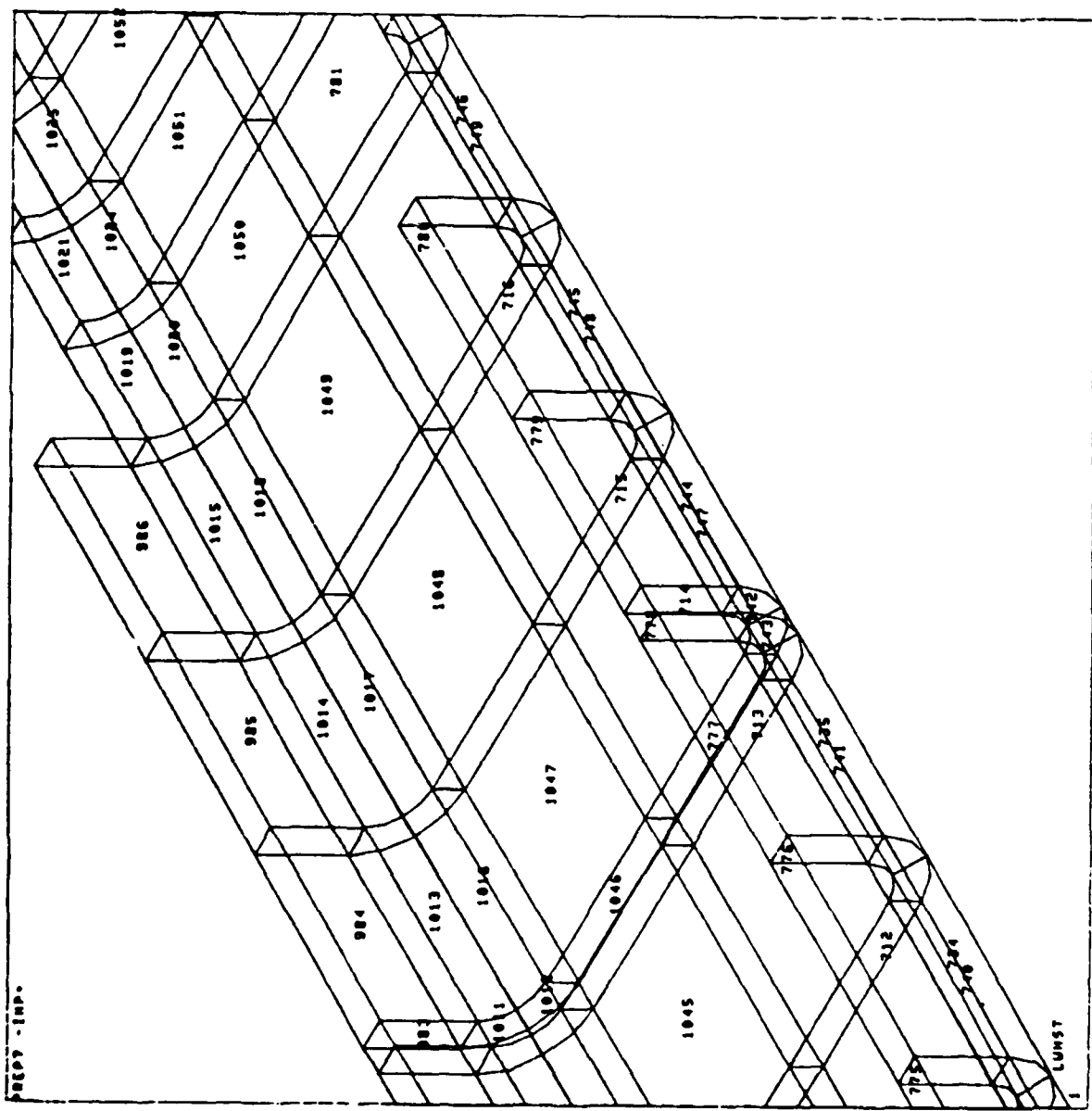
ZOOM
XU=1
VU=1
ZU=1
DIST=51.3
XF=20.1
VF=24.8
ZF=61.8
XRTQ=1.38
VRTQ=1.53

CORE

LUMPST

CORE

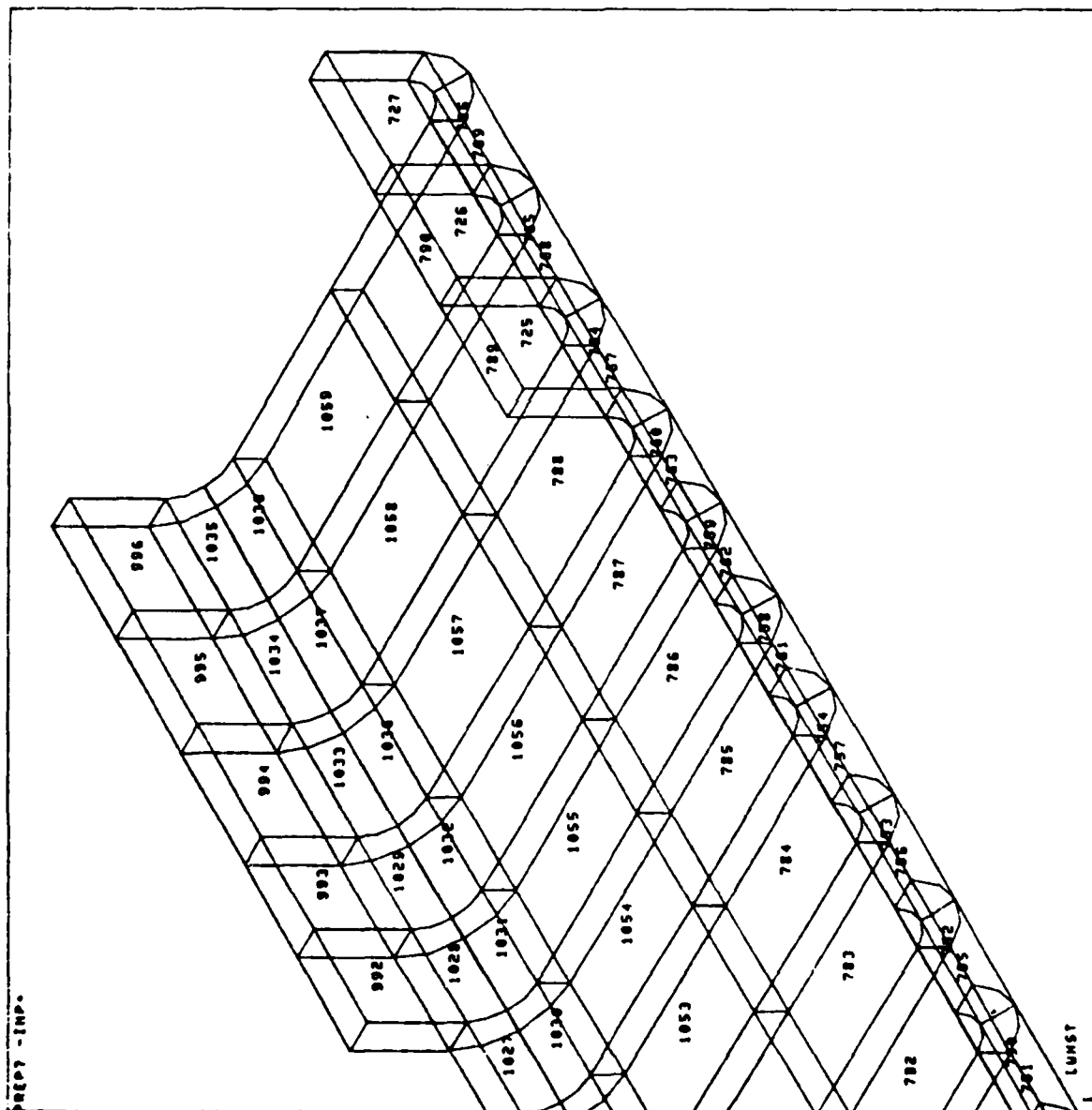
ANSYS 4.28
DEC 15 1986
16155129
PREP7 ELEMENTS
ENUR=1
200H
XU=-1
YU=-1
ZU=1
1 3157-44.9
2 1F-6.58
3 1F-6.26
4 2F-120
5 XRT0-1.5
6 YRT0-1.53



CORE

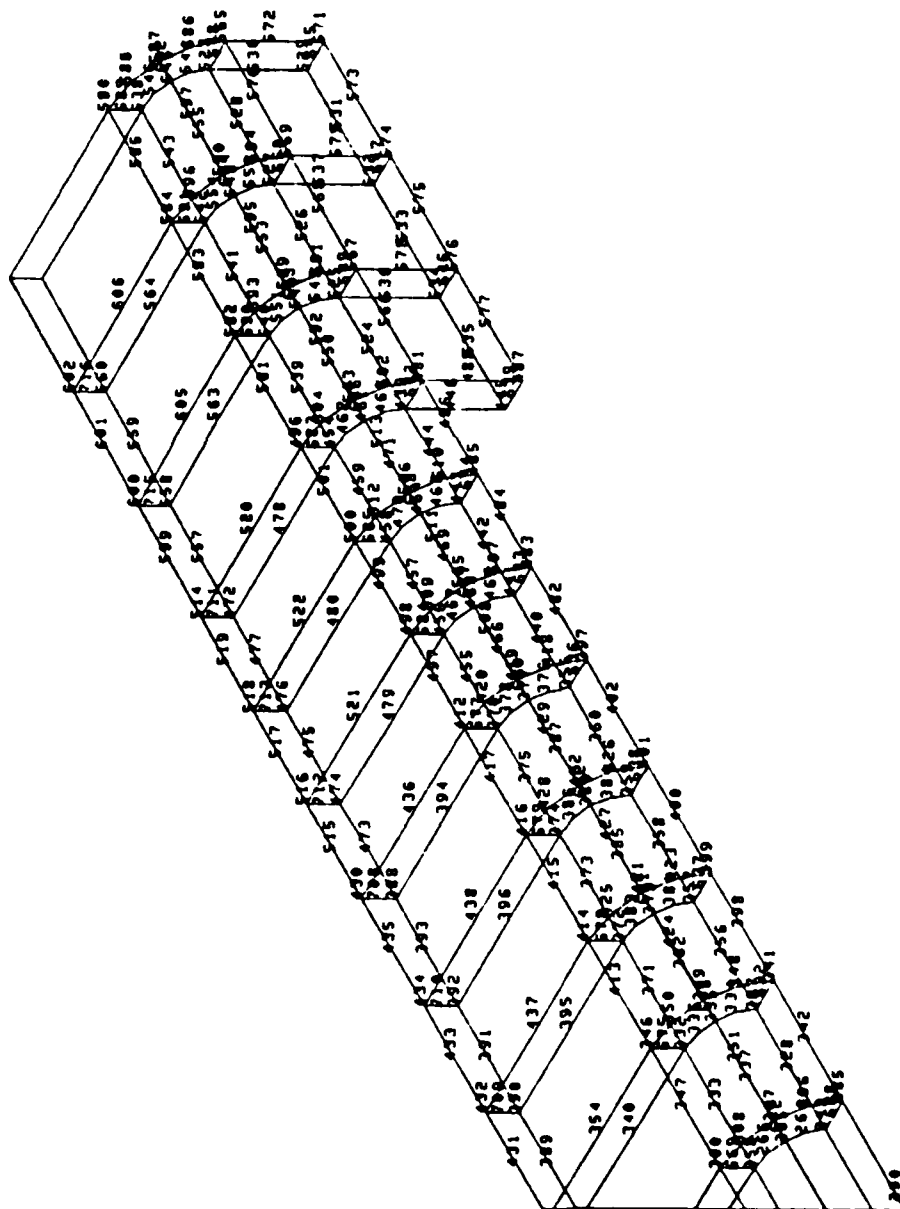
ANSYS 4.2B
DEC 15 1986
16156146
PREP7 ELEMENTS
ENUR=1

ZOOM
XU=-1
YU=-1
ZU=1
DIST=44.3
XF=24.8
YF=21.4
ZF=176
XRTD=1.5
YRTD=1.53

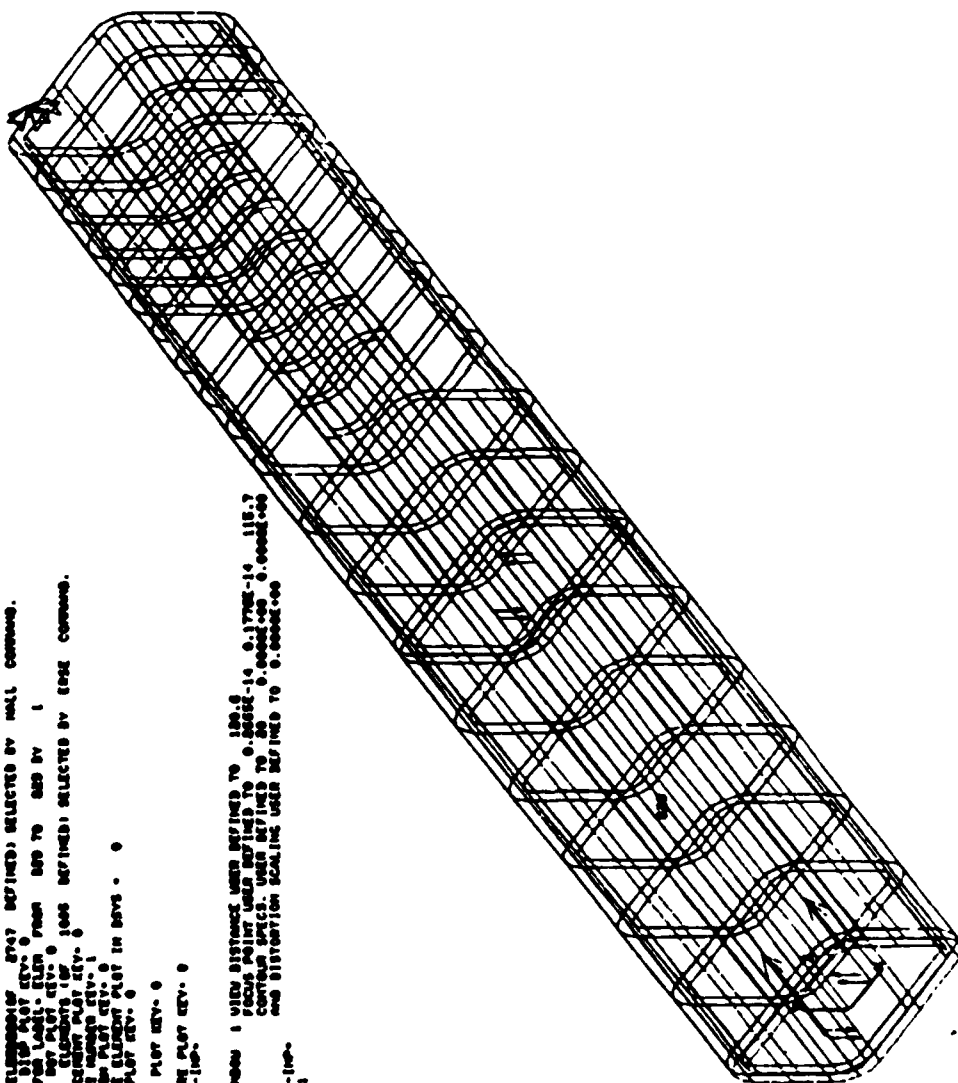


ANSYS 4.20
DEC 15 1986
16:47:36
PREP7 ELEMENTS

CORE



17)

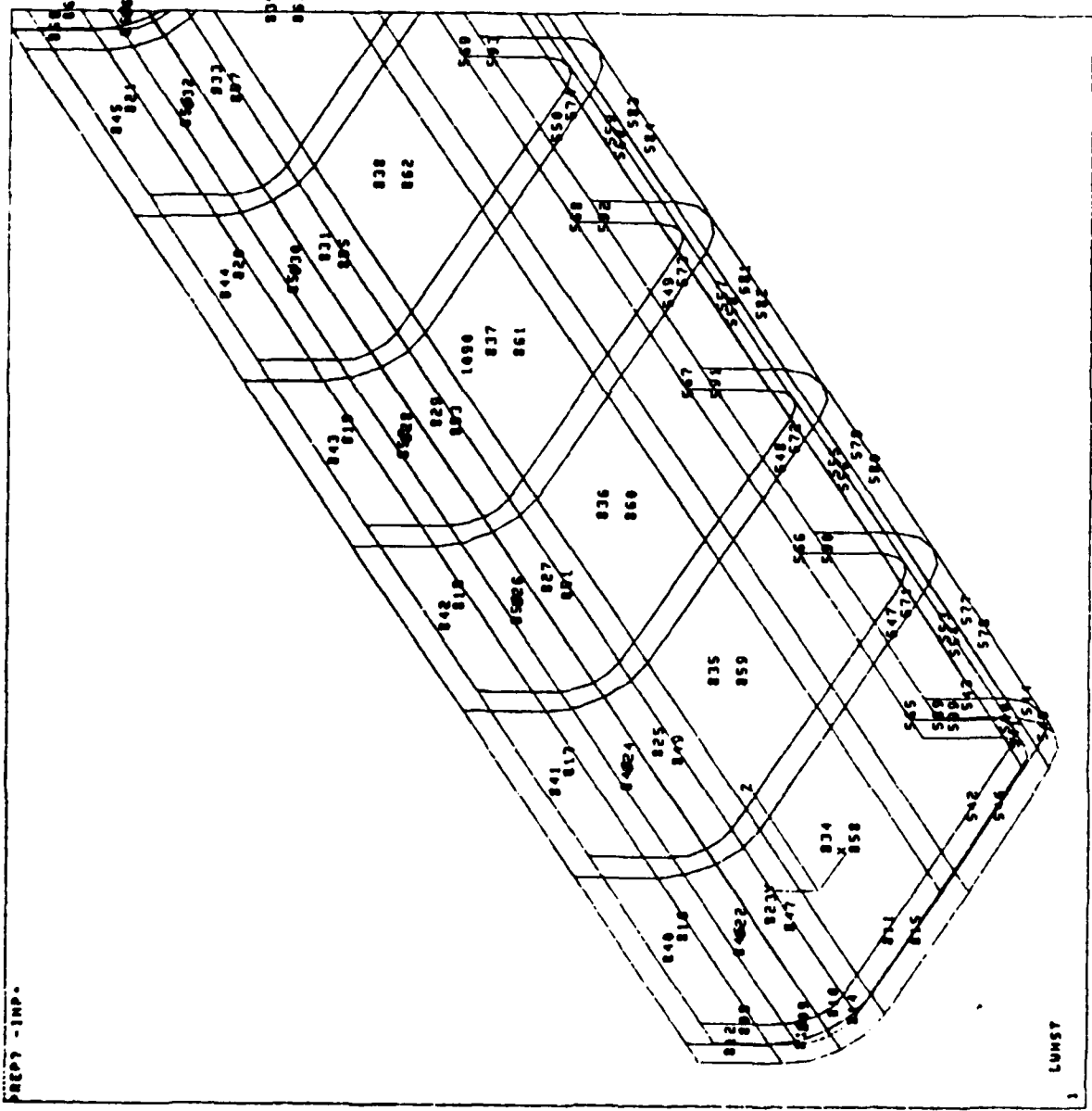
[illegible]

1

ANSYS 4.88
 DEC 15 1986
 17104155
 PREP7 ELEMENTS
 EMUR=1
 ZOOM
 KU=-1
 VU=-1
 20=1
 1 DIST=100
 2 KF=-20.0
 3 VF=-26.1
 4 XRT0=2.56
 5 VRT0=3.02

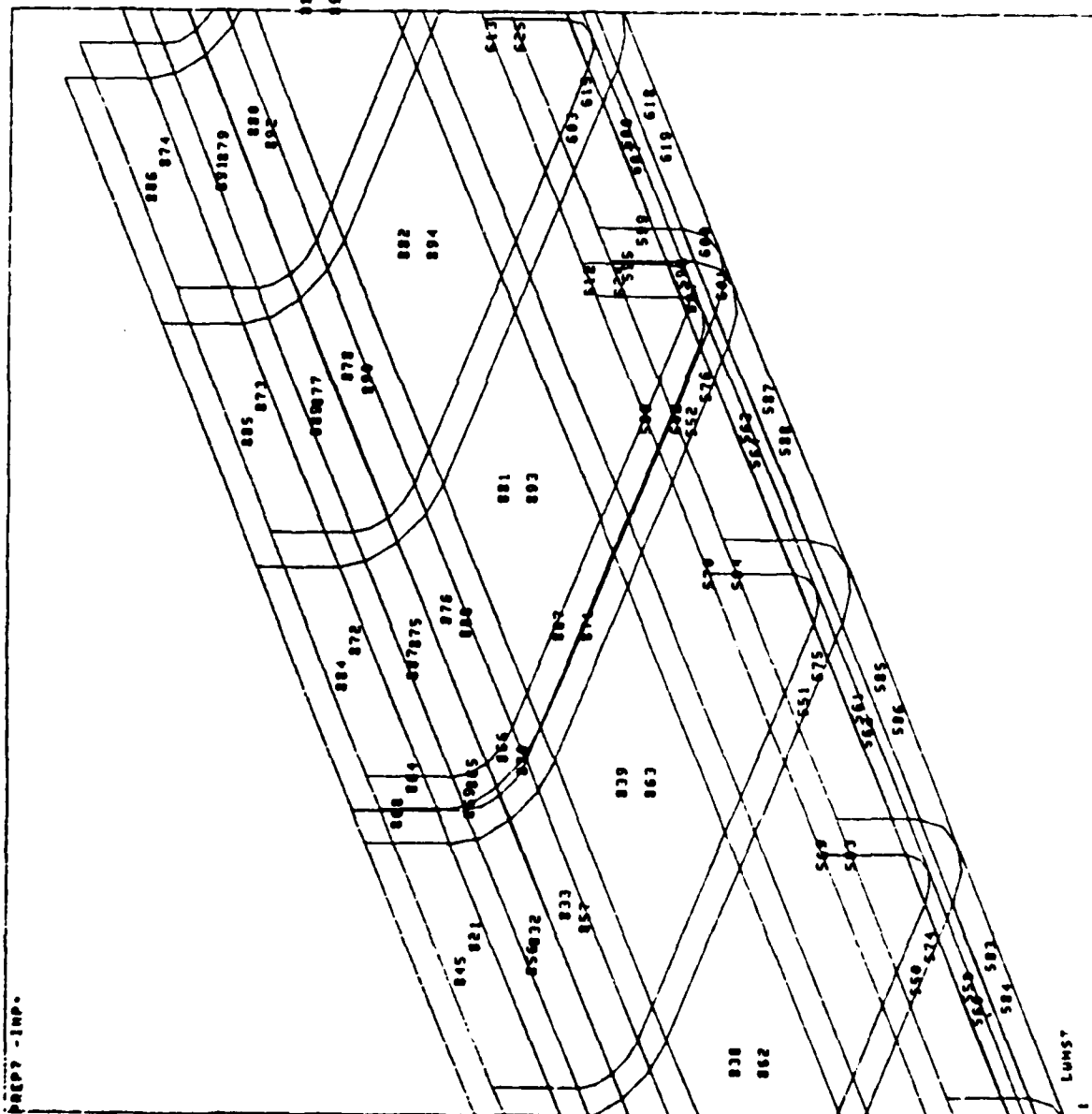
COMPOSITE
ELEMENTS

WALLS L,R
 OUTER
 INNER
 WALLS, T,B
 OUTER

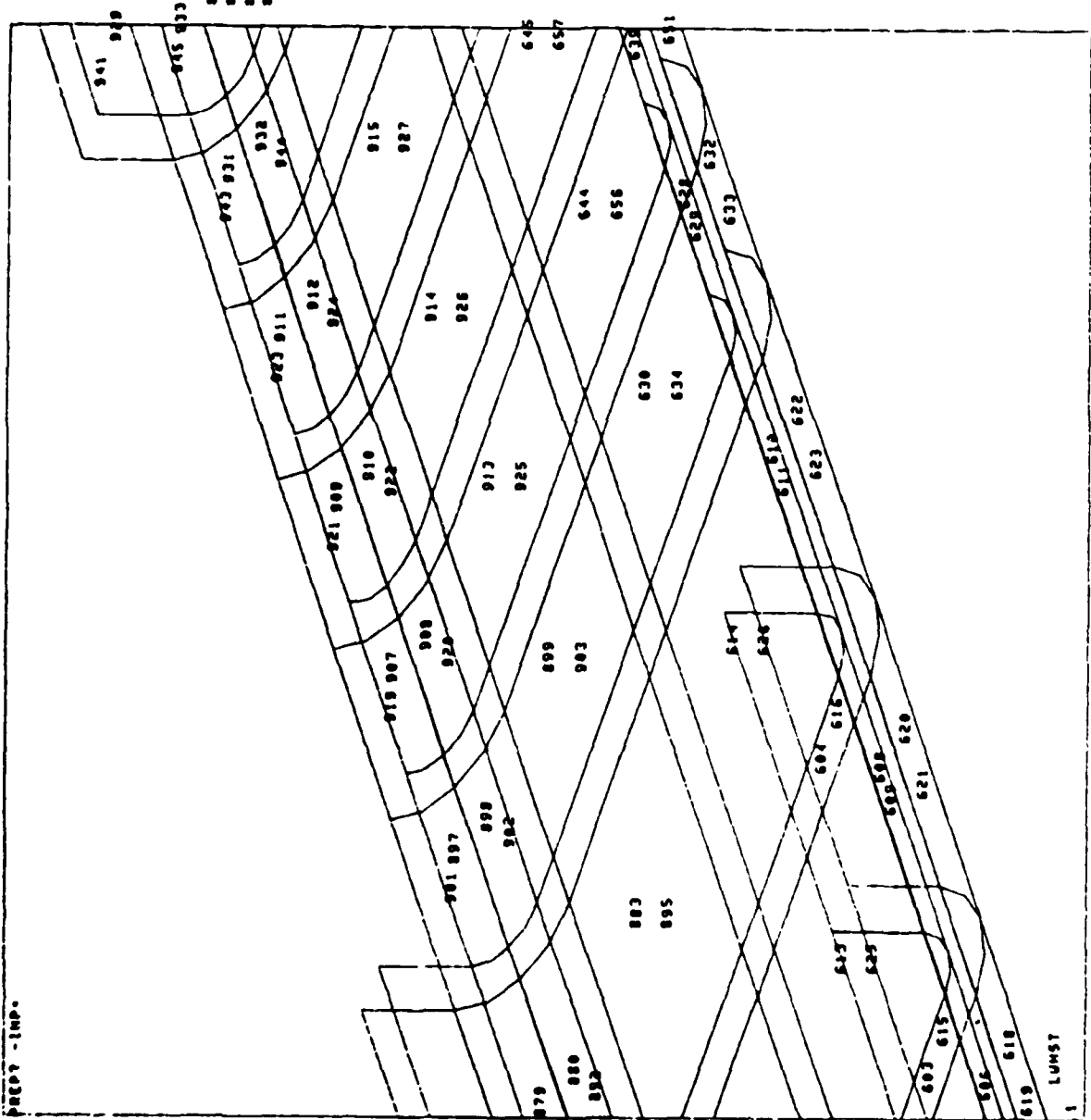


Page - 100 -

56
C8
Z00M
XU--1
YU--1
ZU--1
Z D151-01.7
Z S4--3.75
Z V5--8.25
Z Z5-100
X95-2.56
Y870-1.82

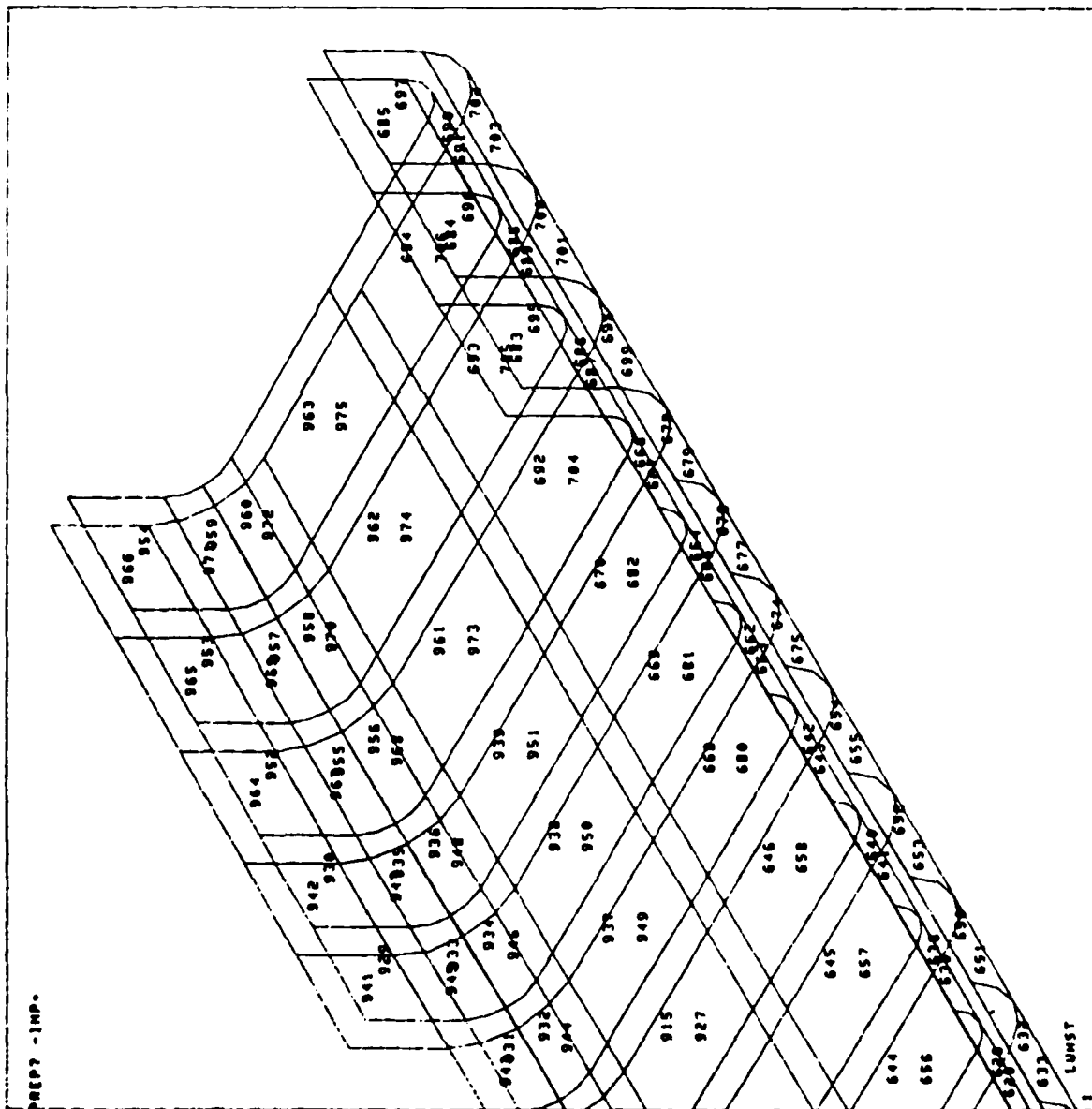


ANSYS 4.20
DEC 15 1986
17:02:39
PREP7 ELEMENTS
EMUN=1
ZOOM
XU=-1
VU=-1
ZU=1
8 DIST=46.6
8 KF=27.4
8 VF=22.8
8 ZF=127
KATO=2.56
VRTO=1.53

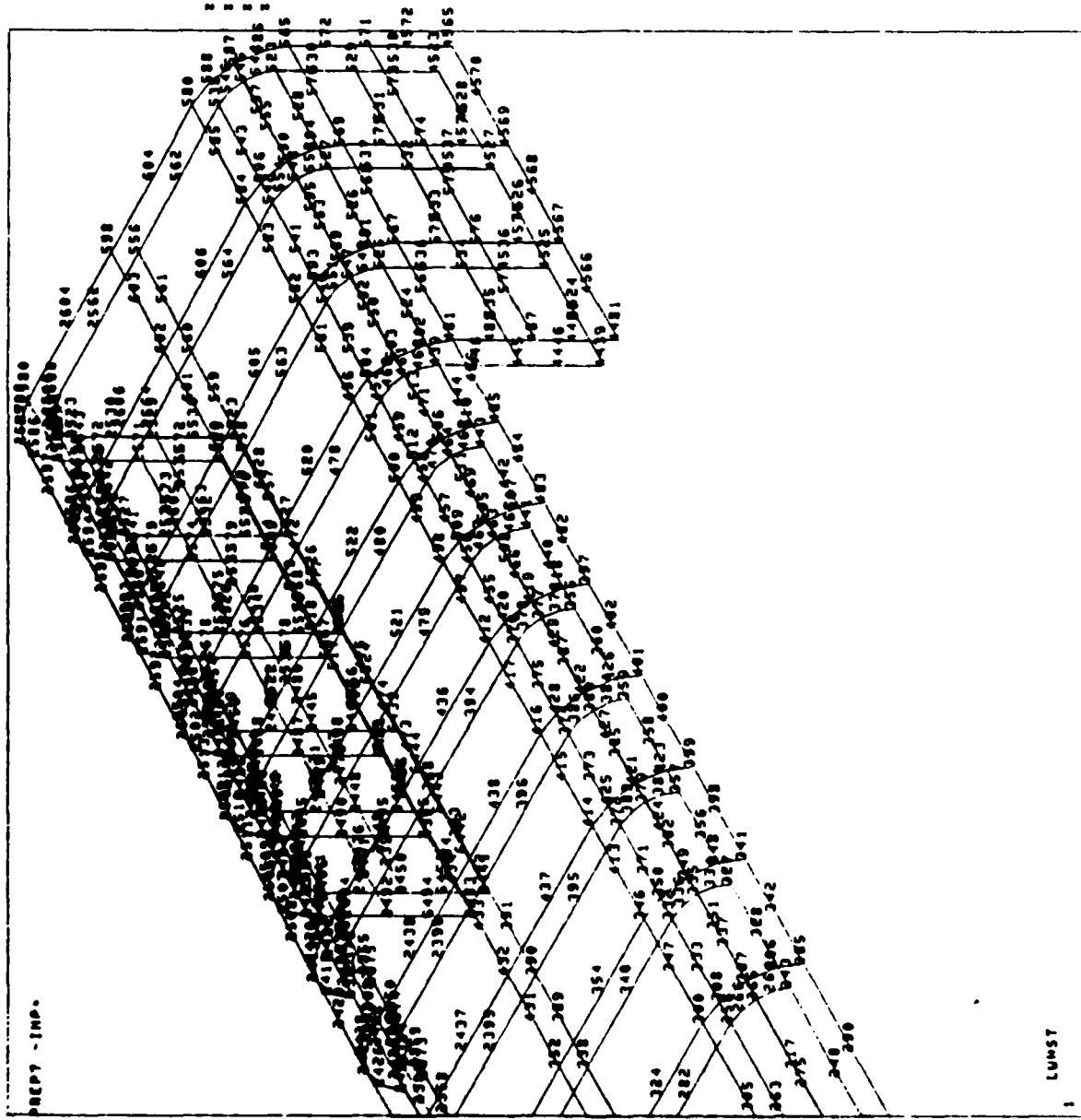


AMSVS 4.20
 DEC 15 1986
 17101182
 PREP7 ELEMENTS
 ENUR-1

ZOOM
 XU=-1
 YU=-1
 ZU=-1
 DIST=44.3
 XF=34.8
 YF=21.4
 ZF=176
 XRT0=1.5
 YRT0=1.53

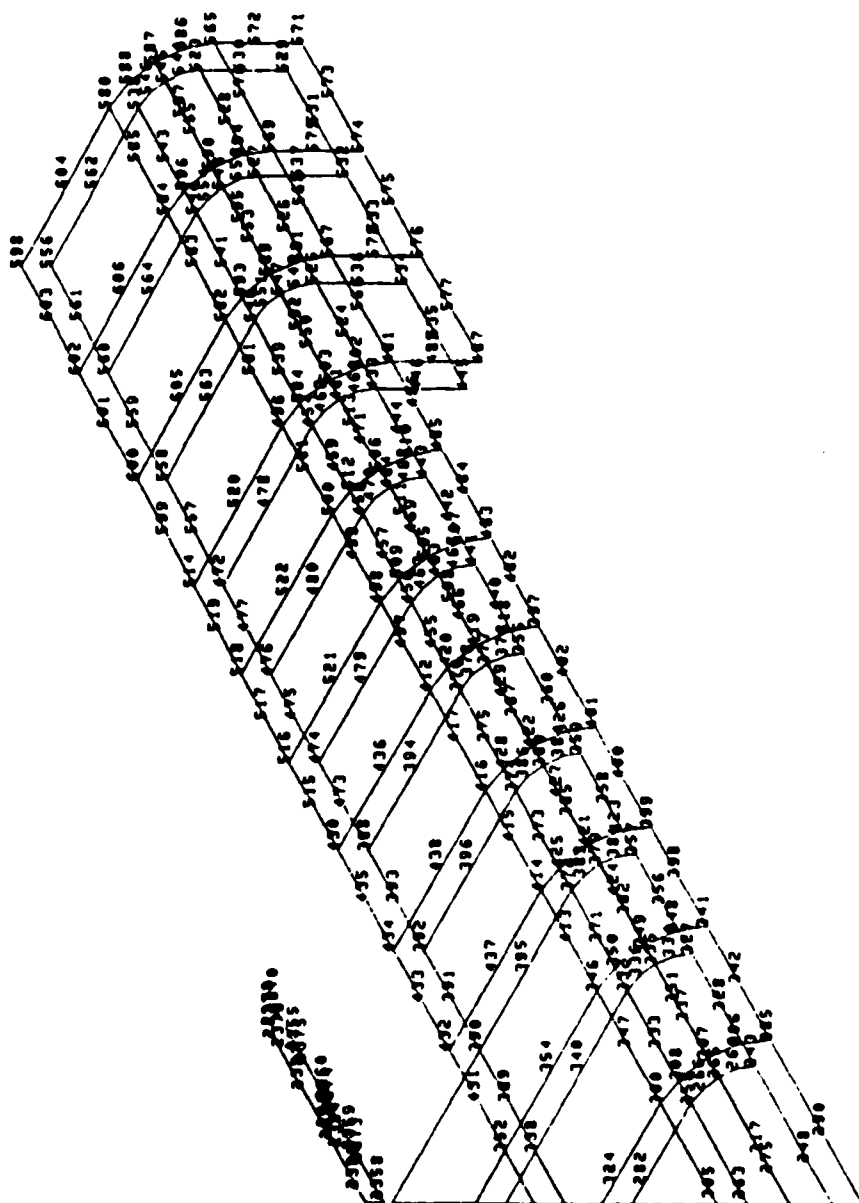


ANSYS 4.23
 DEC 15 1986
 17:10:54
 PREP7 ELEMENTS
 MMUR-1
 ZOOM
 KU--1
 VU--1
 ZU--1
 DIST-141
 WF-32.5
 VF-24
 ZF-171
 WRT0-4.23
 WRT0-4.12

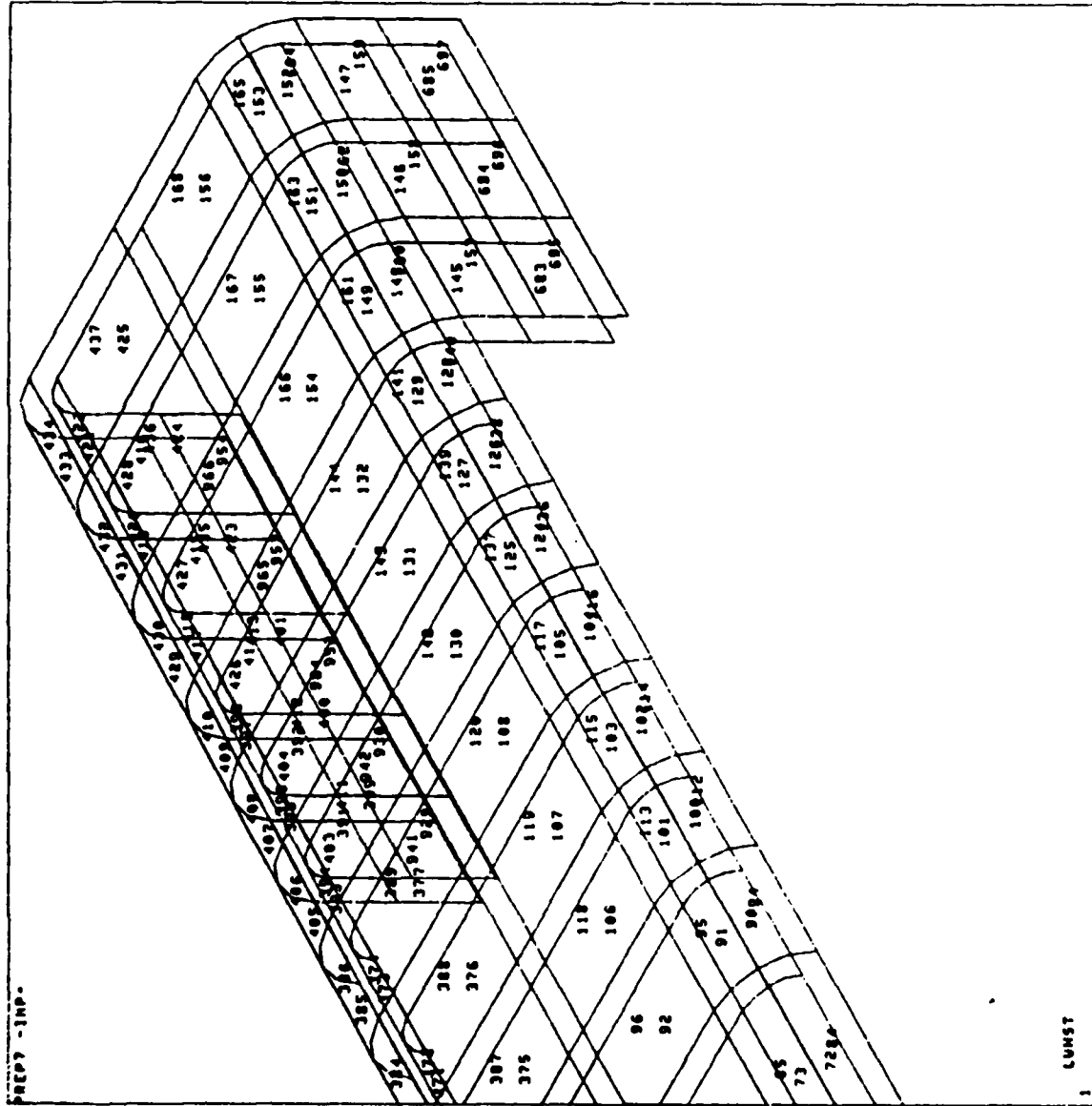


2.1)

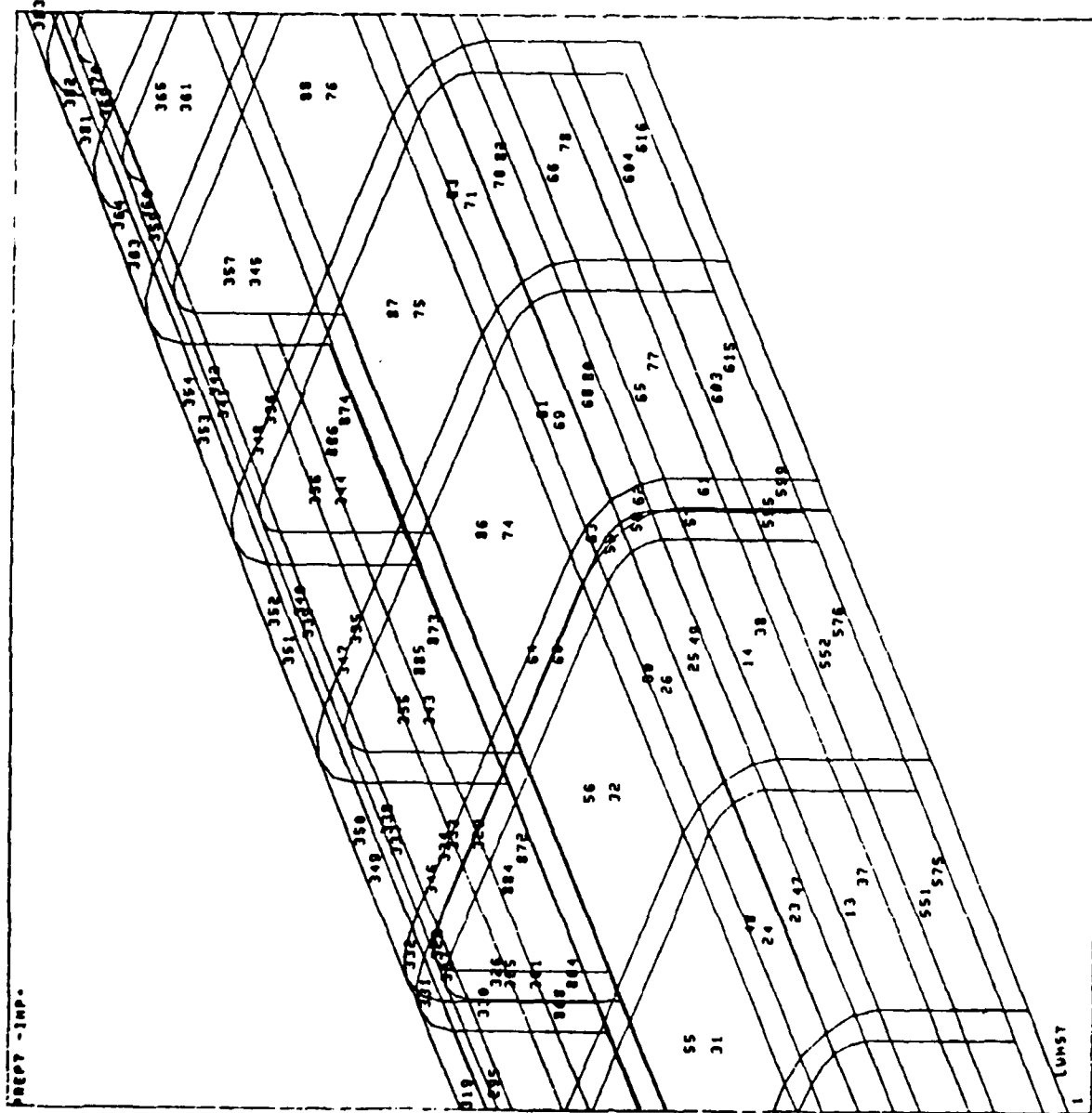
ANSYS 4.20
DEC 15 1986
17:10:54
PREP7 ELEMENTS



ANSYS 4.20
 DEC 15 1986
 17:09:26
 PREP7 ELEMENTS
 ENUR-1
 200H
 KU--1
 VU--1
 2U-1
 2 D187-141
 2 KF-32.5
 2 VF-24
 2 ZF-171
 KRTO-4.23
 VRT0-4.12

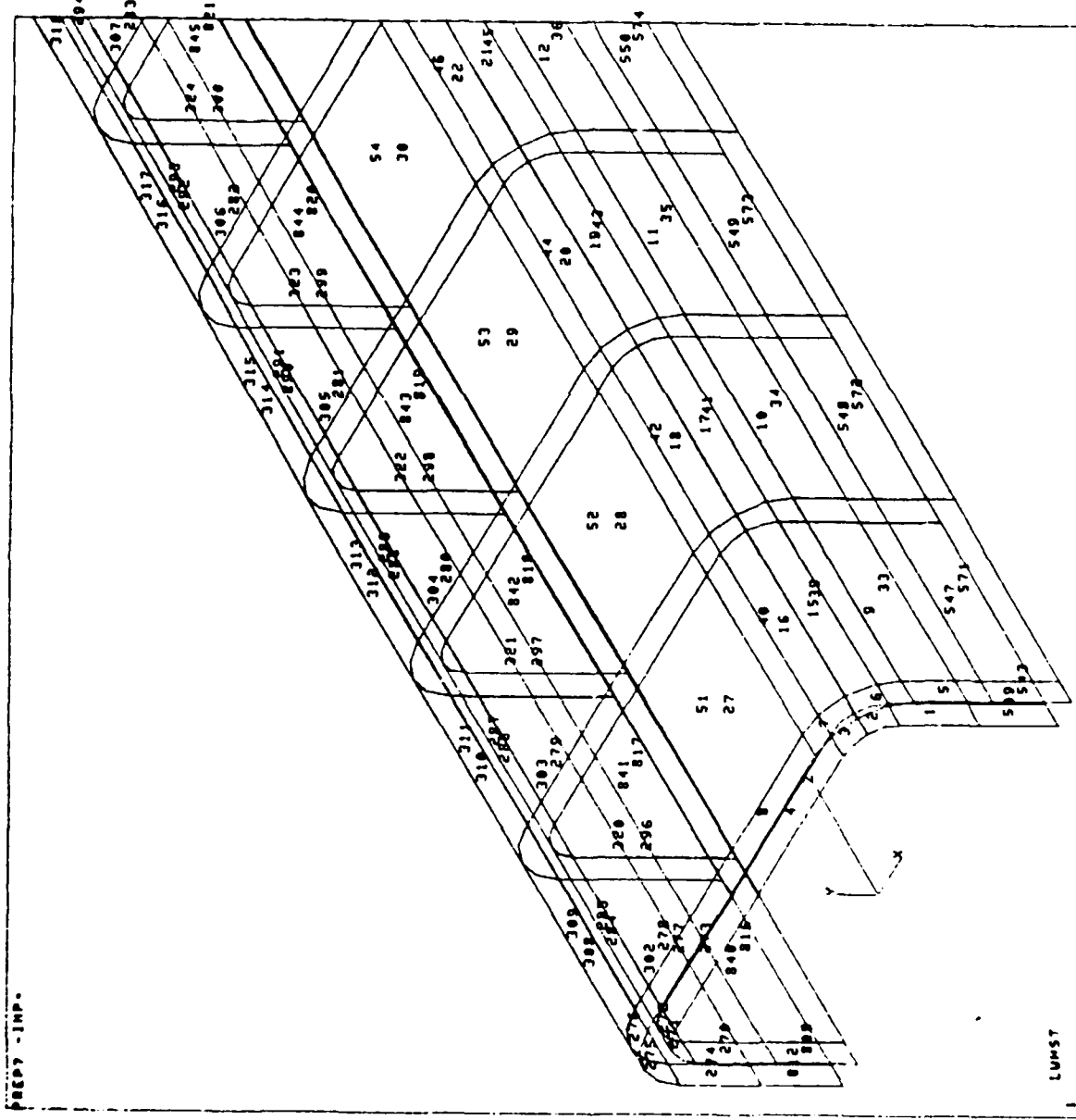


ANSYS 4.20
 DEC 15 1986
 17108111
 PREP7 ELEMENTS
 ENUR-1
 ZOOM
 XU=-1
 YU=-1
 ZU=-1
 2 BIST-113
 2 XF-1.32
 2 YF-1.83
 2 ZF-118
 KRTQ-4.23
 VRTQ-3.02



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ANSYS 4.28
 DEC 15 1986
 17106153
 PREP7 ELEMENTS
 ENUM=1
 ZOOM
 KU=-1
 VU=-1
 ZU=1
 D157-106
 XF=-31.7
 VF=-20.9
 ZF=62.1
 XRT0-2.92
 YRT0-3.02

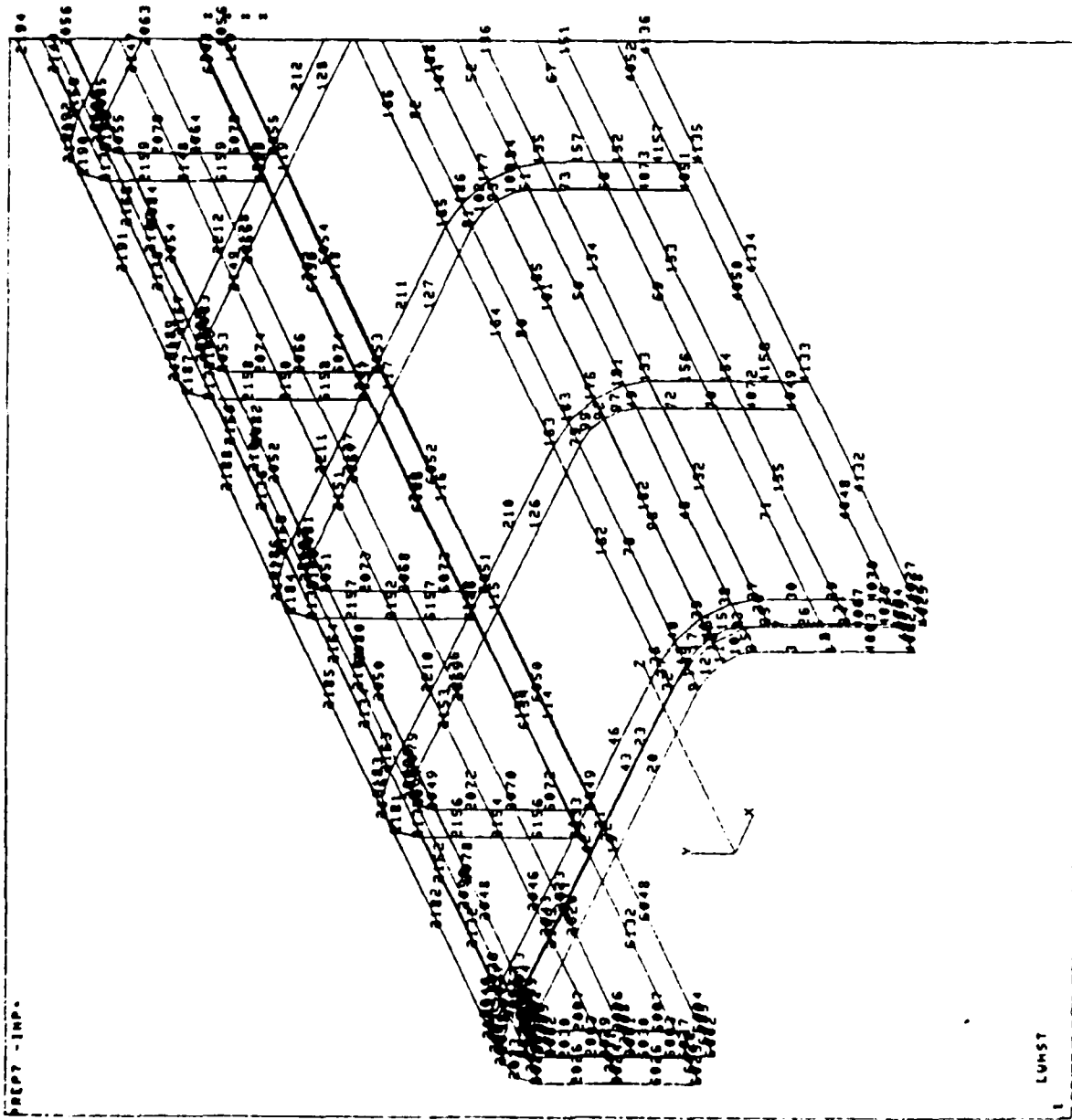


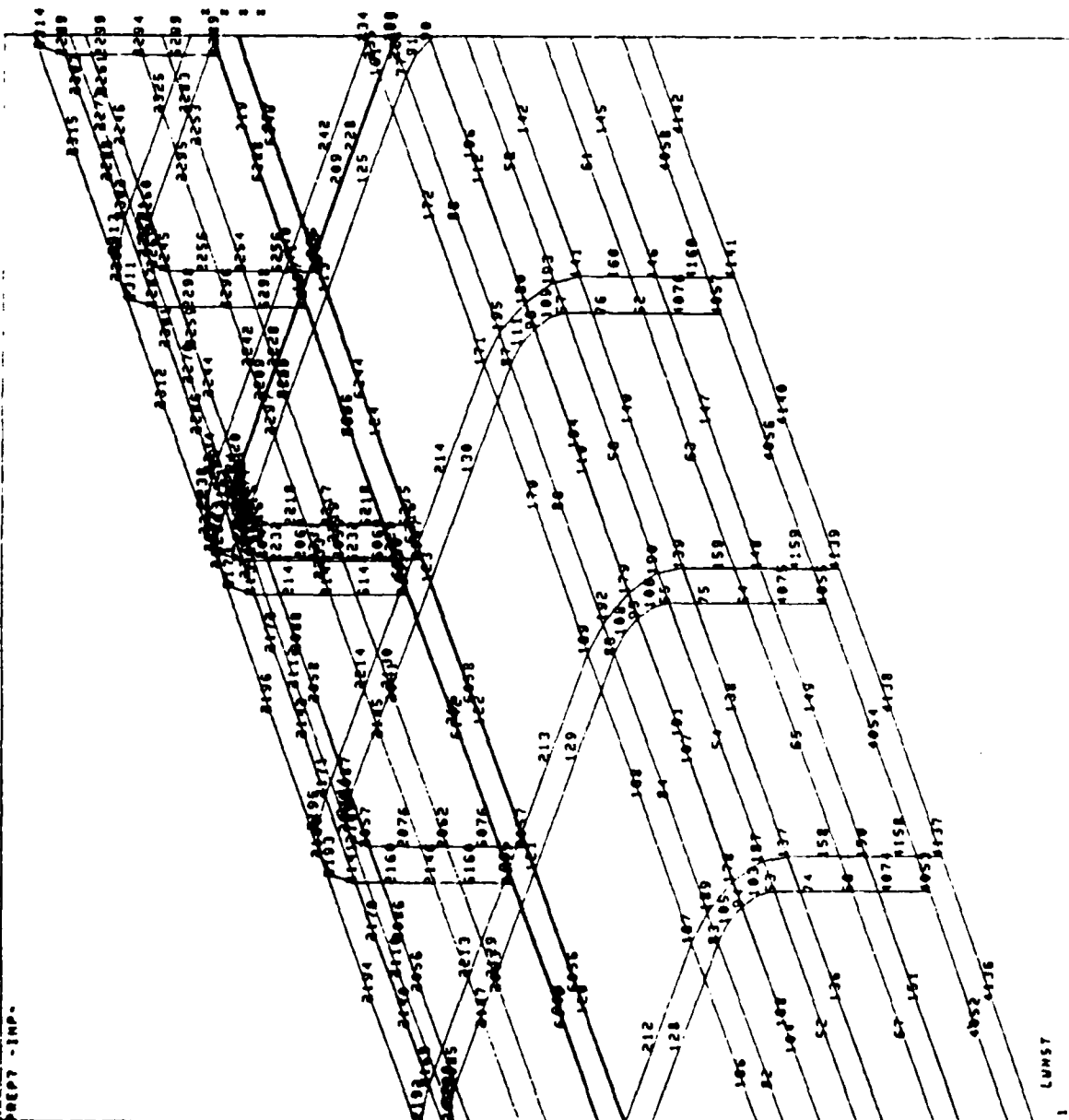
PREP7 -IMP.

LUMST

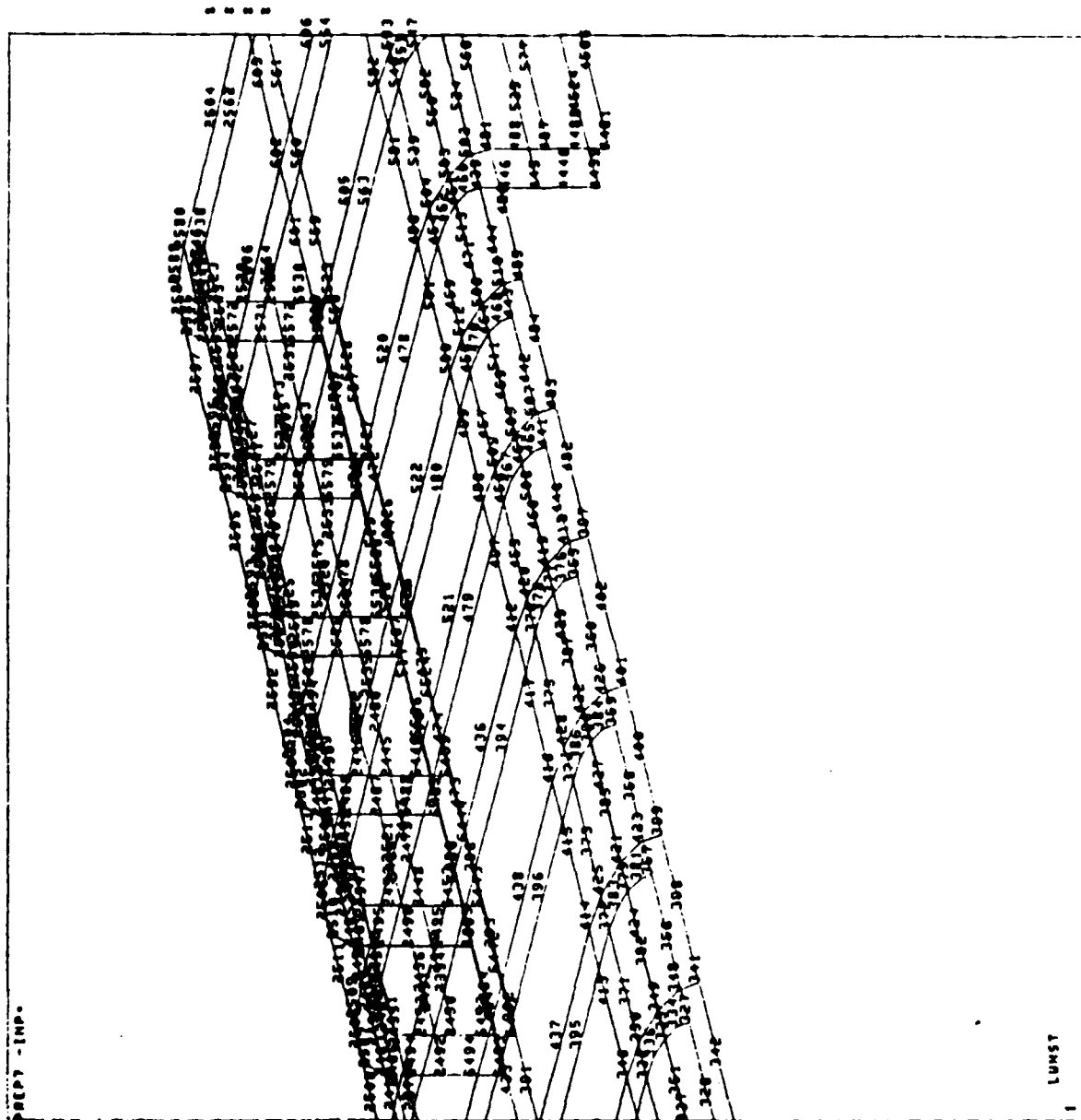
11)

ANSYS 4.2B
 DEC 16 1986
 17113114
 PREP7 ELEMENTS
 MNUR=1
 ZOOM
 XU=-1
 VU=-1
 ZU=1
 DIST=147
 XFA=-32.7
 YFA=-27.8
 ZFA=54.2
 XRT0=4.91
 YRT0=4.17



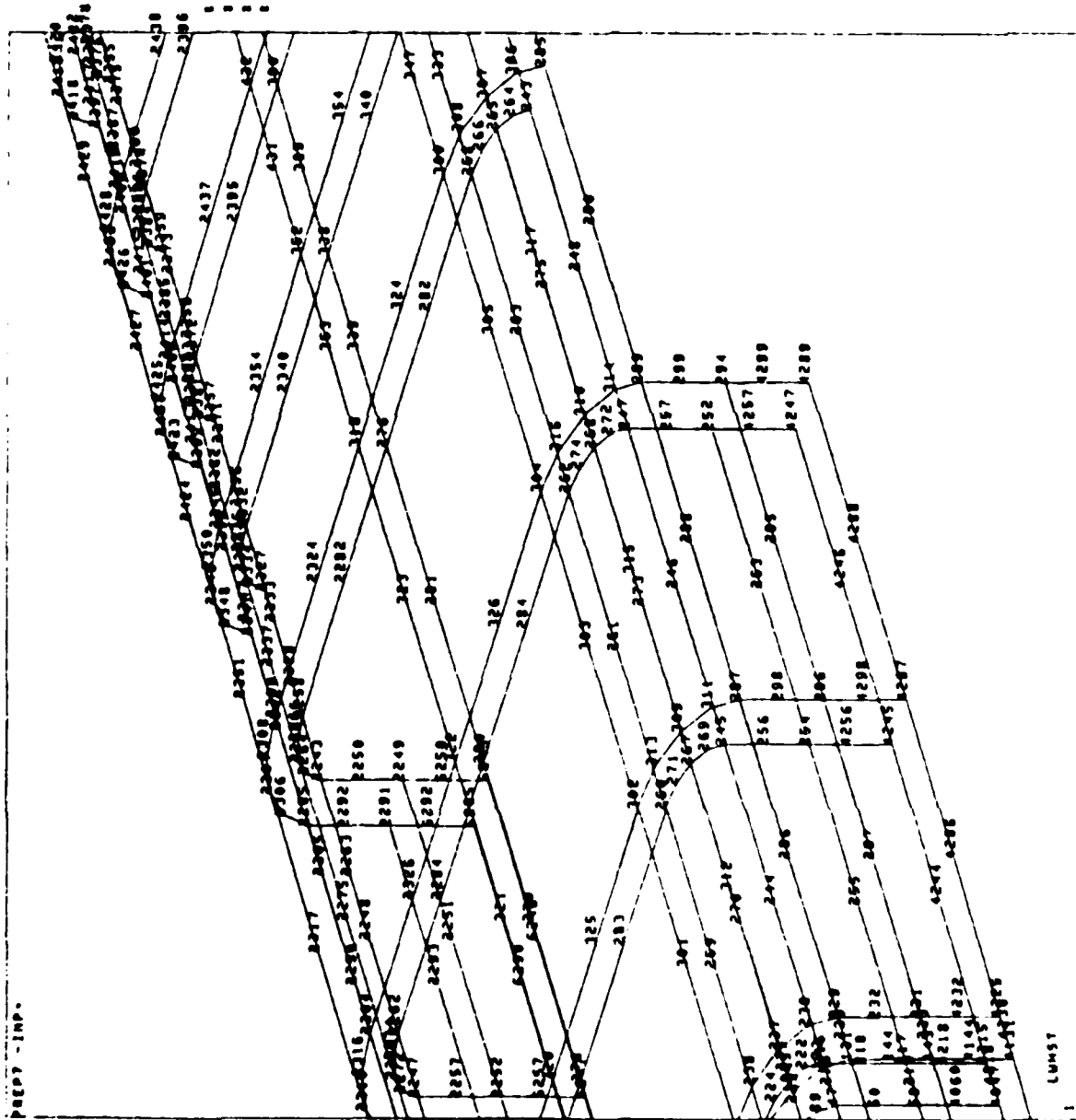


ANSYS 4.23
 DEC 15 1986
 17:10:57
 PREP7 ELEMENTS
 MMUR-1
 ZOOM
 ZU--1
 ZU--1
 ZU--1
 DIST-189
 XE-30.7
 YF-24.7
 ZF-170
 MOTO-9.62
 VMT0-4.17



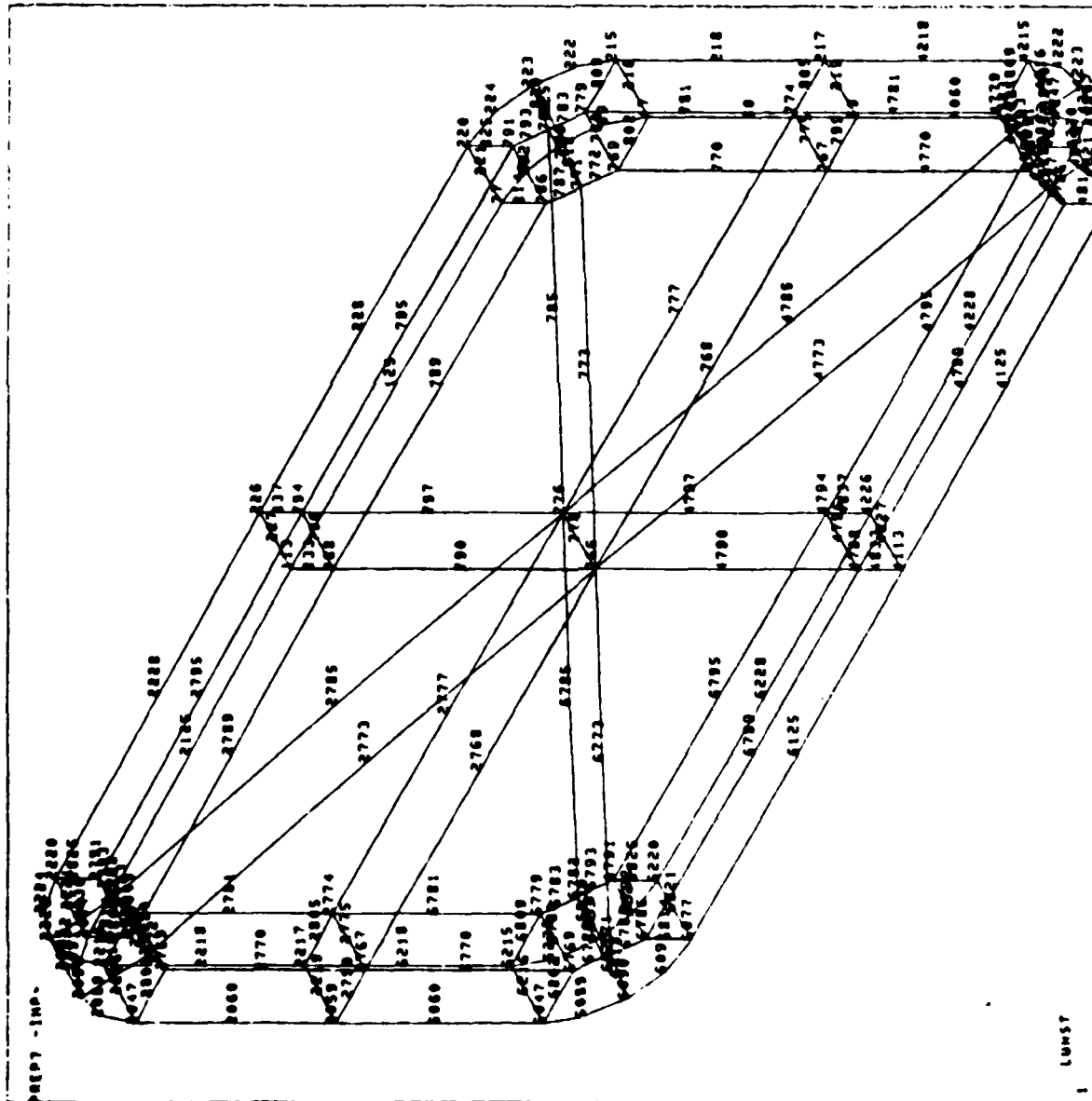
LUMST

ANSYS 4.2B
 DEC 15 1986
 1711727
 PREPT ELEMENTS
 MNUR=1
 ZOOM
 KU=-1
 VU=-1
 20=1
 1 DIST=142
 2 XF=10.6
 3 VF=10.6
 4 ZF=136
 5 ARTO=7.81
 6 VRTO=4.17

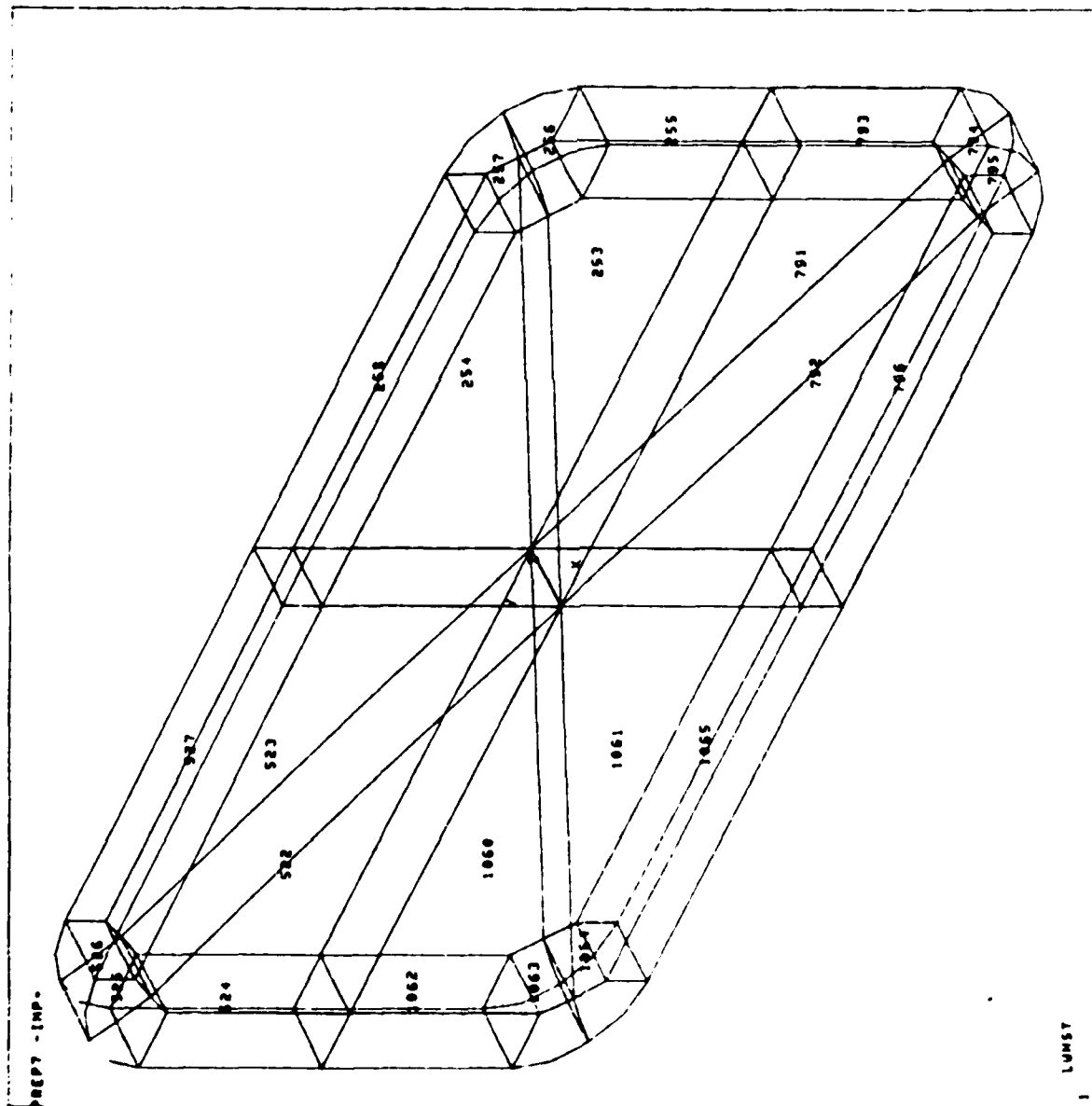


(32)

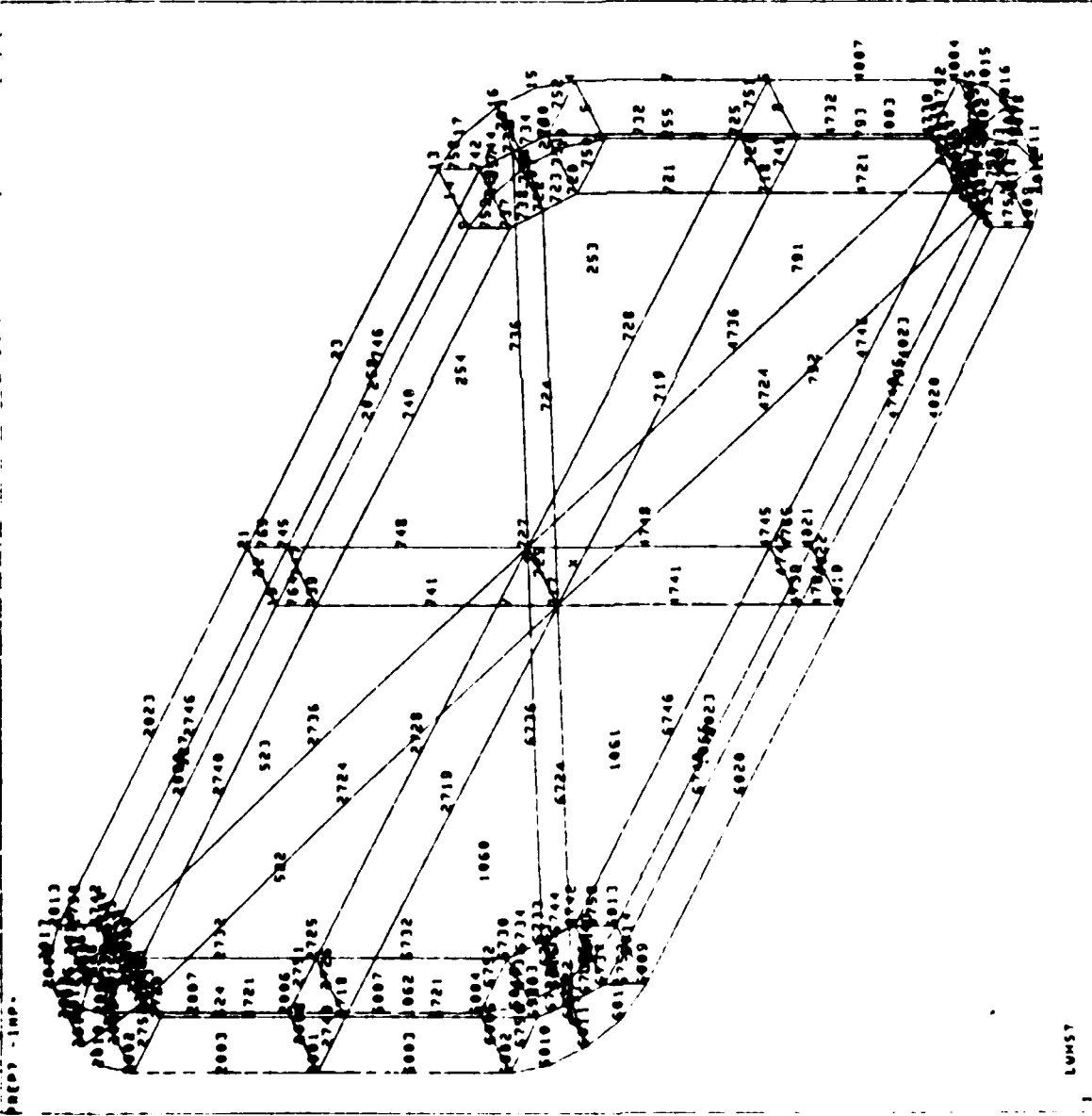
ANSYS 4.29
 DEC 15 1986
 17:26:05
 PREP7 ELEMENTS
 MMUA-1
 ZOOM
 PU--1
 VU--1
 ZU-1
 2 DIST-13.8
 2 XF-17
 2 VF-18.1
 2 ZF-88.5
 2 RTD-1.02



ANSYS 4.28
 DEC 15 1986
 17123137
 PREP7 ELEMENTS
 CMUR.1
 2008
 KU--1
 VU--1
 20-1
 8 DIST-15
 8 XF--17.1
 8 VF--17.6
 8 ZF--18.7
 8 XRT0-1.12

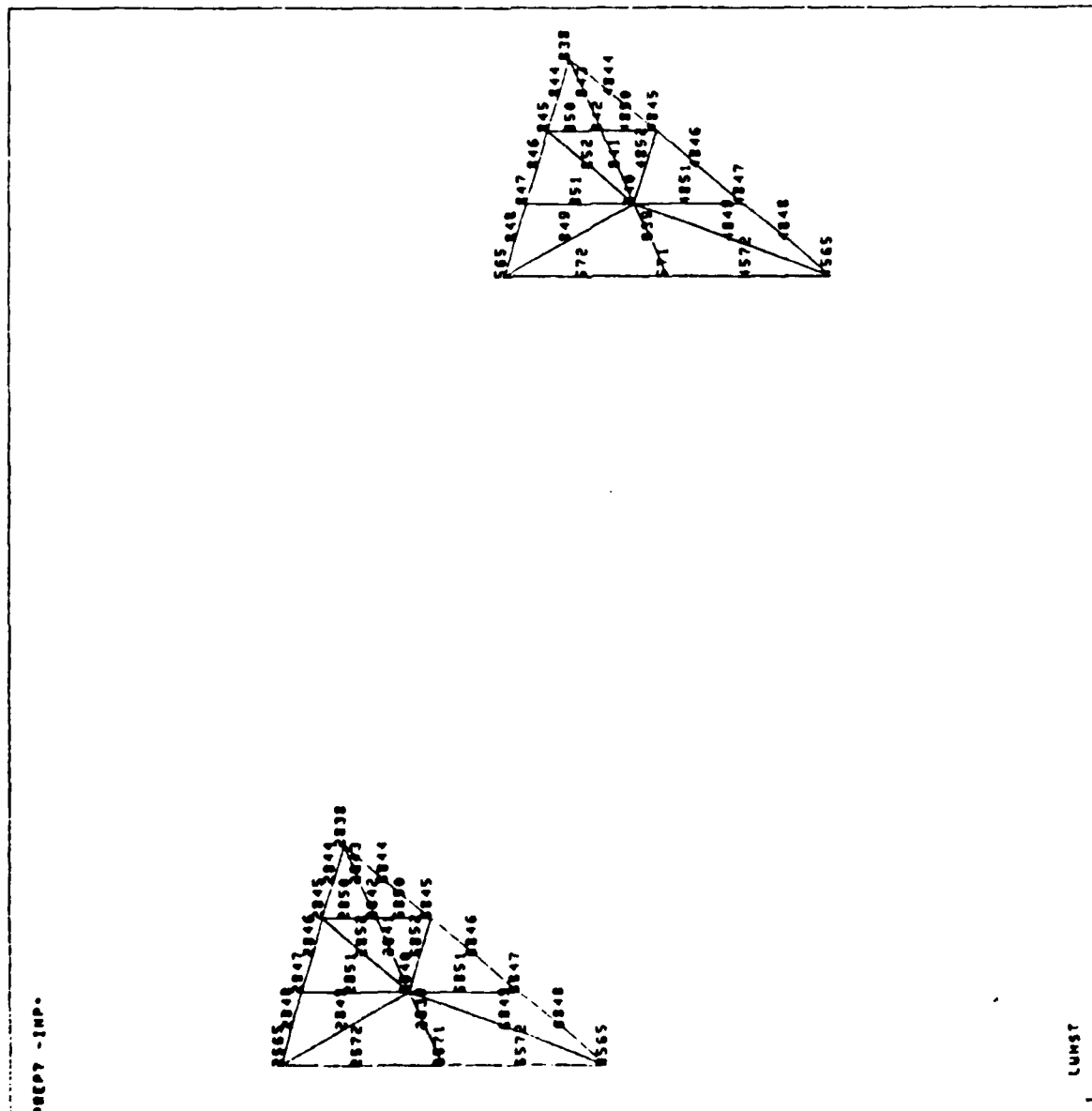


ANSYS 4.20
 DEC 15 1986
 17:22:36
 PREP7 ELEMENTS
 ENUR=1
 MMUR=1
 ZOOM
 AU=-1
 VU=-1
 ZU=1
 * DIST=15
 * KFE=17.1
 * VFE=17.6
 * ZFE=18.7
 * XRT0=1.12



177

ANSYS 4.20
 DEC 15 1986
 17127102
 PREP7 ELEMENTS
 MMUR=1
 ZOOM
 KU=-.8
 VU=-.6
 ZU=-1
 DIST=20.1
 XF=1.00
 YF=-1.23
 ZF=236
 KATO=1.02



ELIST.073.207.1
LIST SELECTED ELEMS. IN RANGE 073 TO 207 BY 1 (LIST NAMES)

ELN	MT	TP	REL	NOES
073	1	1	1	2000
074	1	1	1	2001
075	1	1	1	2002
076	1	1	1	2003
077	1	1	1	2004
078	1	1	1	2005
079	1	1	1	2006
080	1	1	1	2007
081	1	1	1	2008
082	1	1	1	2009
083	1	1	1	2010
084	1	1	1	2011
085	1	1	1	2012
086	1	1	1	2013
087	1	1	1	2014
088	1	1	1	2015
089	1	1	1	2016
090	1	1	1	2017
091	1	1	1	2018
092	1	1	1	2019
093	1	1	1	2020
094	1	1	1	2021
095	1	1	1	2022
096	1	1	1	2023
097	1	1	1	2024
098	1	1	1	2025
099	1	1	1	2026
100	1	1	1	2027
101	1	1	1	2028
102	1	1	1	2029
103	1	1	1	2030
104	1	1	1	2031
105	1	1	1	2032
106	1	1	1	2033
107	1	1	1	2034
108	1	1	1	2035
109	1	1	1	2036
110	1	1	1	2037
111	1	1	1	2038
112	1	1	1	2039
113	1	1	1	2040
114	1	1	1	2041
115	1	1	1	2042
116	1	1	1	2043
117	1	1	1	2044
118	1	1	1	2045
119	1	1	1	2046
120	1	1	1	2047
121	1	1	1	2048
122	1	1	1	2049
123	1	1	1	2050
124	1	1	1	2051
125	1	1	1	2052
126	1	1	1	2053
127	1	1	1	2054
128	1	1	1	2055
129	1	1	1	2056
130	1	1	1	2057
131	1	1	1	2058
132	1	1	1	2059
133	1	1	1	2060
134	1	1	1	2061
135	1	1	1	2062
136	1	1	1	2063
137	1	1	1	2064
138	1	1	1	2065
139	1	1	1	2066
140	1	1	1	2067
141	1	1	1	2068
142	1	1	1	2069
143	1	1	1	2070
144	1	1	1	2071
145	1	1	1	2072
146	1	1	1	2073
147	1	1	1	2074
148	1	1	1	2075
149	1	1	1	2076
150	1	1	1	2077
151	1	1	1	2078
152	1	1	1	2079
153	1	1	1	2080
154	1	1	1	2081
155	1	1	1	2082
156	1	1	1	2083
157	1	1	1	2084
158	1	1	1	2085
159	1	1	1	2086
160	1	1	1	2087
161	1	1	1	2088
162	1	1	1	2089
163	1	1	1	2090
164	1	1	1	2091
165	1	1	1	2092
166	1	1	1	2093
167	1	1	1	2094
168	1	1	1	2095
169	1	1	1	2096
170	1	1	1	2097
171	1	1	1	2098
172	1	1	1	2099
173	1	1	1	2100
174	1	1	1	2101
175	1	1	1	2102
176	1	1	1	2103
177	1	1	1	2104
178	1	1	1	2105
179	1	1	1	2106
180	1	1	1	2107
181	1	1	1	2108
182	1	1	1	2109
183	1	1	1	2110
184	1	1	1	2111
185	1	1	1	2112
186	1	1	1	2113
187	1	1	1	2114
188	1	1	1	2115
189	1	1	1	2116
190	1	1	1	2117
191	1	1	1	2118
192	1	1	1	2119
193	1	1	1	2120
194	1	1	1	2121
195	1	1	1	2122
196	1	1	1	2123
197	1	1	1	2124
198	1	1	1	2125
199	1	1	1	2126
200	1	1	1	2127
201	1	1	1	2128
202	1	1	1	2129
203	1	1	1	2130
204	1	1	1	2131
205	1	1	1	2132
206	1	1	1	2133
207	1	1	1	2134

NOTE: (YES, NO OR CONTINUOUS).

ELN	MT	TP	REL	NOES
208	1	1	1	2135
209	1	1	1	2136
210	1	1	1	2137
211	1	1	1	2138
212	1	1	1	2139
213	1	1	1	2140
214	1	1	1	2141
215	1	1	1	2142
216	1	1	1	2143
217	1	1	1	2144
218	1	1	1	2145
219	1	1	1	2146
220	1	1	1	2147
221	1	1	1	2148
222	1	1	1	2149
223	1	1	1	2150
224	1	1	1	2151
225	1	1	1	2152
226	1	1	1	2153
227	1	1	1	2154
228	1	1	1	2155
229	1	1	1	2156
230	1	1	1	2157
231	1	1	1	2158
232	1	1	1	2159
233	1	1	1	2160
234	1	1	1	2161
235	1	1	1	2162
236	1	1	1	2163
237	1	1	1	2164
238	1	1	1	2165
239	1	1	1	2166
240	1	1	1	2167
241	1	1	1	2168
242	1	1	1	2169
243	1	1	1	2170
244	1	1	1	2171
245	1	1	1	2172
246	1	1	1	2173
247	1	1	1	2174
248	1	1	1	2175
249	1	1	1	2176
250	1	1	1	2177
251	1	1	1	2178
252	1	1	1	2179
253	1	1	1	2180
254	1	1	1	2181
255	1	1	1	2182
256	1	1	1	2183
257	1	1	1	2184
258	1	1	1	2185
259	1	1	1	2186
260	1	1	1	2187
261	1	1	1	2188
262	1	1	1	2189
263	1	1	1	2190
264	1	1	1	2191
265	1	1	1	2192
266	1	1	1	2193
267	1	1	1	2194
268	1	1	1	2195
269	1	1	1	2196
270	1	1	1	2197
271	1	1	1	2198
272	1	1	1	2199
273	1	1	1	2200
274	1	1	1	2201
275	1	1	1	2202
276	1	1	1	2203
277	1	1	1	2204
278	1	1	1	2205
279	1	1	1	2206
280	1	1	1	2207
281	1	1	1	2208
282	1	1	1	2209
283	1	1	1	2210
284	1	1	1	2211
285	1	1	1	2212
286	1	1	1	2213
287	1	1	1	2214
288	1	1	1	2215
289	1	1	1	2216
290	1	1	1	2217
291	1	1	1	2218
292	1	1	1	2219
293	1	1	1	2220
294	1	1	1	2221
295	1	1	1	2222
296	1	1	1	2223
297	1	1	1	2224
298	1	1	1	2225
299	1	1	1	2226
300	1	1	1	2227

ELN	MT	TP	REL	NOES
312	1	1	1	2167
313	1	1	1	2170
314	1	1	1	2179
315	1	1	1	2180
316	1	1	1	2180
317	1	1	1	2181
318	1	1	1	2181
319	1	1	1	2181
320	1	1	1	2181
321	1	1	1	2181
322	1	1	1	2181
323	1	1	1	2181
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334	1	1	1	2181
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389	1	1	1	2181
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393	1	1	1	2181
394	1	1	1	2181
395	1	1	1	2181
396	1	1	1	2181
397	1	1	1	2181
398	1	1	1	2181
399	1	1	1	2181
400	1	1	1	2181

NEXT PAGE

[illegible]

LIST SELECTED ELEM. IN RANGE 770 TO 800 BY 1 (LIST NODES)									
ELEM MAT TYP DEL									
770	2	2	2	2	2	2	2	2	2
771	2	2	2	2	2	2	2	2	2
772	2	2	2	2	2	2	2	2	2
773	2	2	2	2	2	2	2	2	2
774	2	2	2	2	2	2	2	2	2
775	2	2	2	2	2	2	2	2	2
776	2	2	2	2	2	2	2	2	2
777	2	2	2	2	2	2	2	2	2
778	2	2	2	2	2	2	2	2	2
779	2	2	2	2	2	2	2	2	2
780	2	2	2	2	2	2	2	2	2
781	2	2	2	2	2	2	2	2	2
782	2	2	2	2	2	2	2	2	2
783	2	2	2	2	2	2	2	2	2
784	2	2	2	2	2	2	2	2	2
785	2	2	2	2	2	2	2	2	2
786	2	2	2	2	2	2	2	2	2
787	2	2	2	2	2	2	2	2	2
788	2	2	2	2	2	2	2	2	2
789	2	2	2	2	2	2	2	2	2
790	2	2	2	2	2	2	2	2	2
791	2	2	2	2	2	2	2	2	2
792	2	2	2	2	2	2	2	2	2
793	2	2	2	2	2	2	2	2	2
794	2	2	2	2	2	2	2	2	2
795	2	2	2	2	2	2	2	2	2
796	2	2	2	2	2	2	2	2	2
797	2	2	2	2	2	2	2	2	2
798	2	2	2	2	2	2	2	2	2
799	2	2	2	2	2	2	2	2	2
800	2	2	2	2	2	2	2	2	2

(19)

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[illegible][illegible]

1187 SELECTED (LJMS. IN RANGE 912 TO 999 PV 1 (LIST ABOVE)

[illegible]

001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031	032	033	034	035	036	037	038	039	040	041	042	043	044	045	046	047	048	049	050	051	052	053	054	055	056	057	058	059	060	061	062	063	064	065	066	067	068	069	070	071	072	073	074	075	076	077	078	079	080	081	082	083	084	085	086	087	088	089	090	091	092	093	094	095	096	097	098	099	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200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D2/390

TORQUE PROGRAM

AAAAA
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FFFFFFFFFF	000000	RRRRRRRR	;;;;	77777777		
FFFFFFFFFF	000000	RRRRRRRR	;;;;	77777777		
FF	00	00	RR	RR	;;;;	77
FF	00	00	RR	RR	;;;;	77
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FFFFFFFF	00	00	RRRRRRRR	;;;;		77
FFFFFFFF	00	00	RRRRRRRR	;;;;		77
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FF	00	00	RR	RR	;;;;	77
FF	00	00	RR	RR	;;	77
FF	00	00	RR	RR	;;	77
FF	000000	RR	RR	;;		77
FF	000000	RR	RR	;;		77

File HSC000\$DUA9:[M20.IRELAND_JV.VMS]TORQUE.FOR;7 (2544,15,1), last revised on 6-FEB-1987 15:14, is a 2 block sequential file owned by UIC [M20,IRELAND_JV]. The records are variable length with implied (CR) carriage control. The longest record is 51 bytes.

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Job AODAT (375) queued to LN on 24-APR-1987 11:31 by user M20E20, UIC
M20, IRELAND JV], under account M22 at priority 100, started on printer
VENUS$TXA6: on 24-APR-1987 11:37 from queue TXA6.

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AAAAAA
AAAAAA
AAAAAA

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TMAX=42500.
PROJOI=.10816
VM=2978.
UM=16.675
TWIST=.613
SIGDDM=TMAX/PROJOI
BQ=2.*UM-27.*SIGDDM*UM*UM/(4.*TWIST*VM*VM)
CQ=UM*UM
B=(-BQ-SQRT(BQ*BQ-4.*CQ))/2.
A=VM*(1.+B/UM)
TM=2.*UM/VM
UO=EXP(LOG(UM)-2.-UM/B)
WRITE (*,'(3X,F8.3,4X,3(F9.7,4X))') A,B,UO,TM
T=0.
TORK=0.
U=0.
PRINT 300,T,TORK,U
U=UO
DT=.0005
DELT=DT/2.
200 VP=A*U/(B+U)
BB=B+U-(VP+A)*DELT
CC=-((VP+A)*U+VP*B)*DELT
DELU=(-BB+SQRT(BB*BB-4.*CC))/2.
DELT2=(B*LOG(1.+DELU/U)+DELU)/A
U=U+DELU+(DT-DELT2)*A*(U+DELU)/(B+U+DELU)
TORK=PROJOI*A*A*B*TWIST*U/(B+U)**3.
T=T+DT
PRINT 300,T,TORK,U
300 FORMAT(3X,F5.4,4X,F7.0,4X,F7.4)
IF(T.LT.TM) GO TO 200
STOP
END
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END

10-87

DTIC